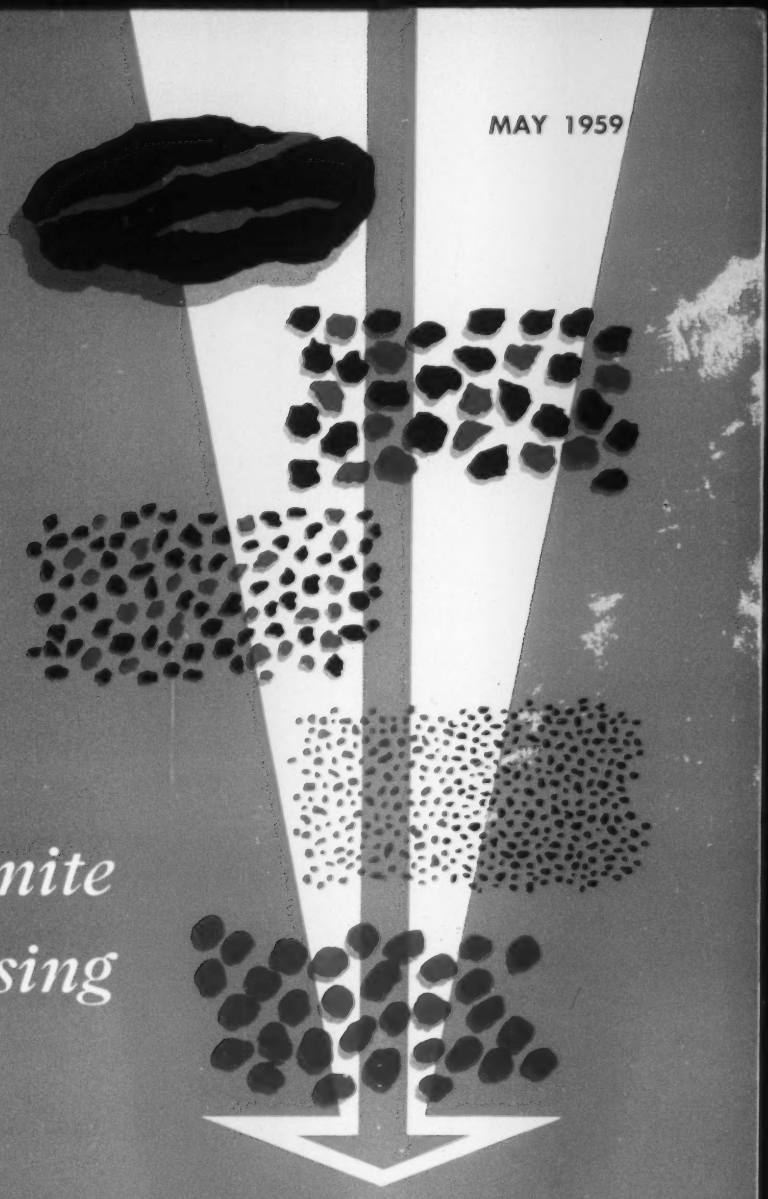
AUTOMATION

MAY 1959



Taconite Processing

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Materials Handling**
- **Casting Steel in Re-Usable Molds**
- **Tape Programmed Multispindle Machine**
- **Controlling Large Flows**

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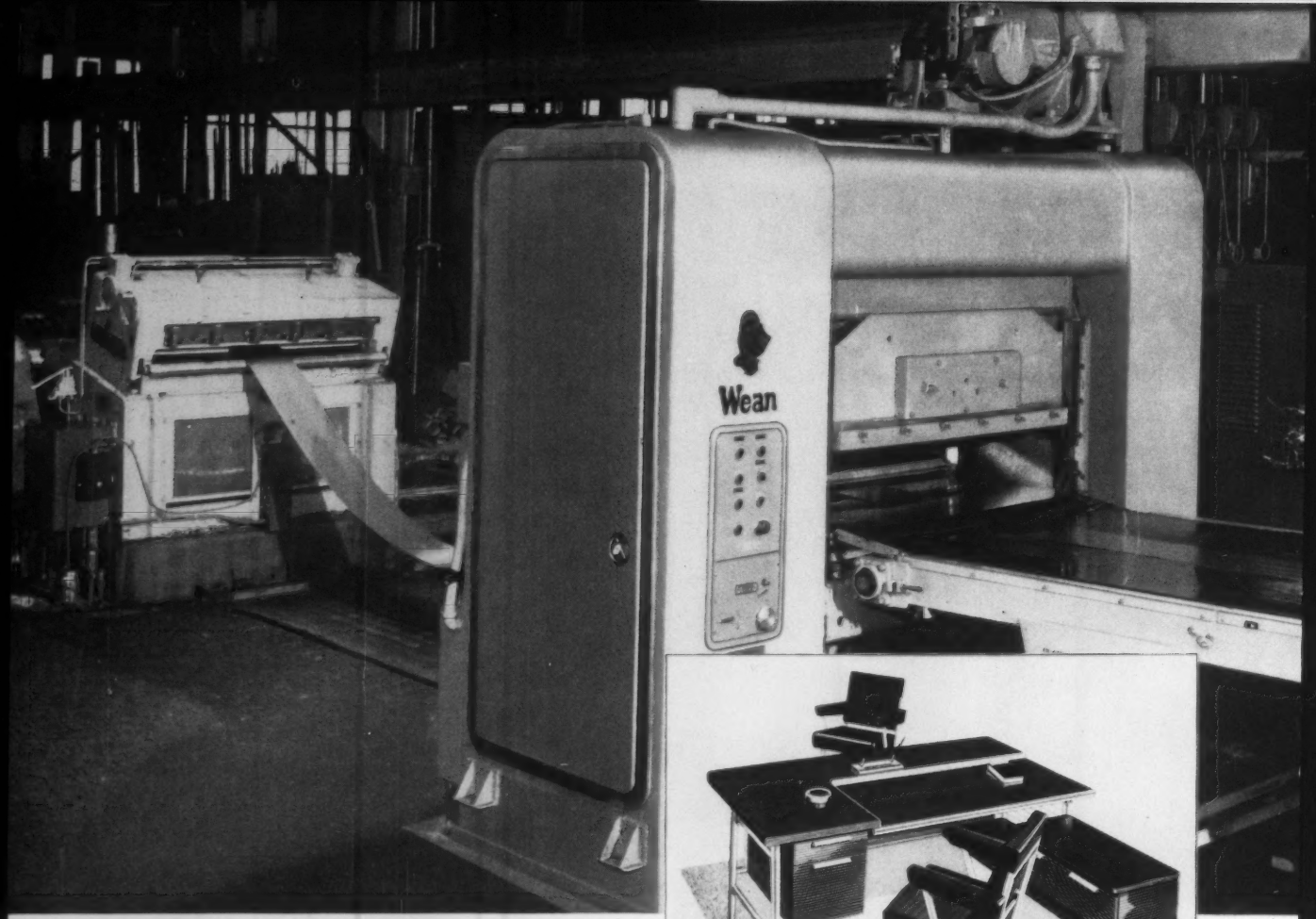
A PENTON PUBLICATION



At General Fireproofing Company...

Material savings alone will pay for Wean coil processing lines in first year

This leading manufacturer of metal business furniture used to buy steel in various size sheets, re-square it and then stretcher-level about 80% of the sheets. Now a Wean slitting line and Wean FLYING PRESS combination shearing and blanking line (including a built-in leveler) make it possible for GF to purchase about 90% of their steel requirements in the more economical coil form. Maintaining a large sheet inventory is no longer necessary and costly re-processing operations have been eliminated entirely.

Based on figures covering the first six months these Wean coil processing lines have been in operation, GF expects material savings in the first year alone will exceed the cost of the equipment. Company officials estimate even greater savings when peak performance of the equipment is realized and when the FLYING PRESS is utilized for simultaneous shearing-blanking operations at a future date.

If you use sheet or strip steel in quantity, it's likely Wean coil processing equipment can reduce your material production costs.

We'll be happy to send you descriptive literature; or, if you prefer, one of our sales engineers will be glad to give you full information.

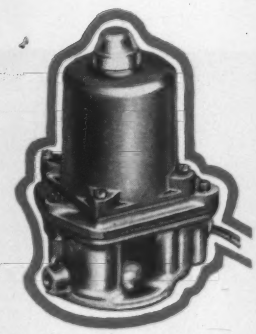
WEAN EQUIPMENT CORPORATION
CLEVELAND 17, OHIO
Detroit • Chicago • Newark

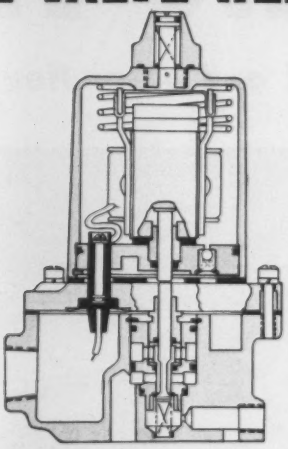
WEAN

Circle 651 on Page 17

a basic Ross *valve building block*

GOLDMODEL VALVE HEAD

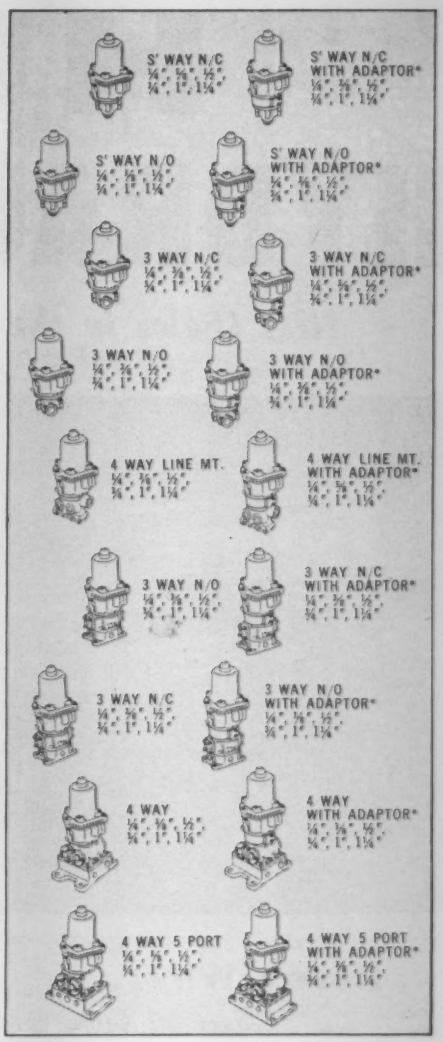


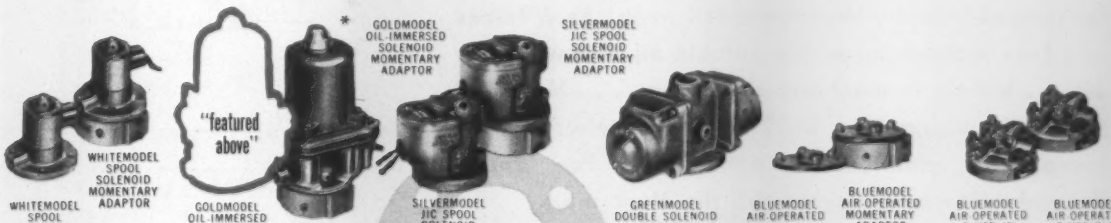


OIL IMMERSED SOLENOID

- The finest achievement in solenoid heads
- JIC
- Over 50 million cycles in tests
- Lightning fast

Modular construction is brought to the air valve field to give you the effect of a great valve inventory without stocking a great number of valves. Stock just one of these Goldmodel heads and you have the finest solenoid actuator obtainable for any one of the 54 Skyline bodies. This is the head designed especially for those uses where dependable performance and very long life must supersede all other considerations. The dustproof solenoid is the very finest and is immersed in oil to run cool and stay young. Write for bulletin 318.


5 WAY N/C
5 WAY N/C WITH ADAPTOR*
5 WAY N/O
5 WAY N/O WITH ADAPTOR*
3 WAY N/C
3 WAY N/C WITH ADAPTOR*
3 WAY N/O
3 WAY N/O WITH ADAPTOR*
4 WAY LINE MT.
4 WAY LINE MT. WITH ADAPTOR*
3 WAY N/O
3 WAY N/C WITH ADAPTOR*
3 WAY N/C
3 WAY N/O WITH ADAPTOR*
4 WAY
4 WAY WITH ADAPTOR*
4 WAY 5 PORT
4 WAY 5 PORT WITH ADAPTOR*



"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES

STRAIGHTWAY NORMALLY OPEN NORMALLY CLOSED
3 WAY NORMALLY OPEN NORMALLY CLOSED
4 WAY
3 WAY NORMALLY OPEN NORMALLY CLOSED
4 WAY
4 WAY 5 PORT

ROSS OPERATING VALVE COMPANY

131 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

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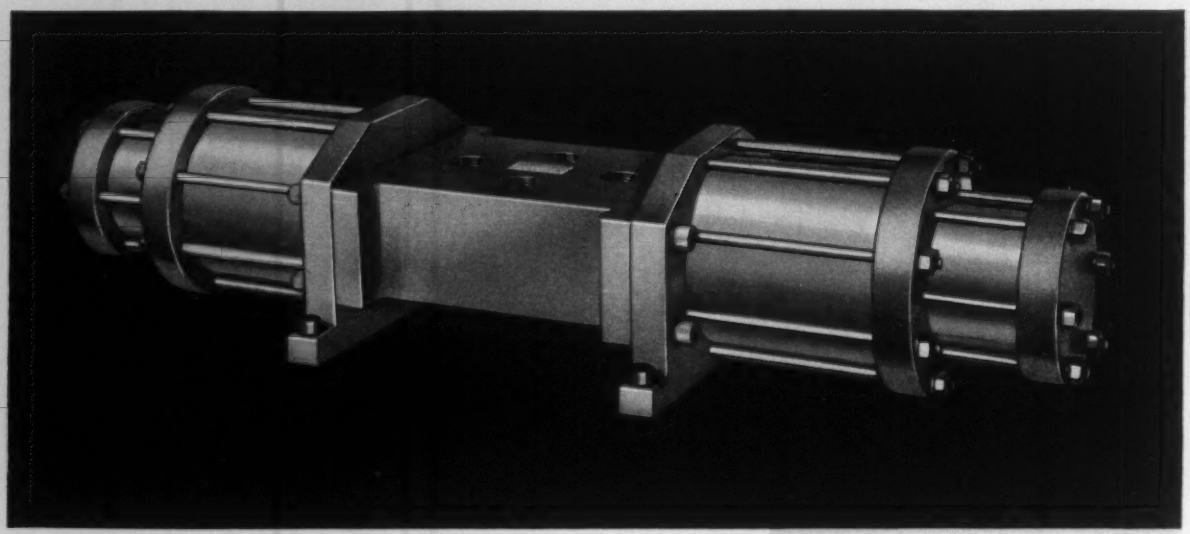
HUNT HYDRAULIC VALVES

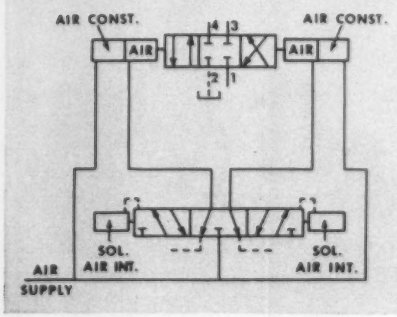
First Choice in the Steel and other Heavy Industries



Here's Why!

Over 20 years of specialized experience designing—and building—hydraulic operating valves for rugged industry requirements . . . ½" to 8" sizes . . . Zero leakage on water, soluble oil and water, or oil . . . Valves to meet any application . . . No metal to metal seating . . . Easy field maintenance . . . Inexpensive maintenance parts . . . For utmost dependability and service call the Hunt man.

1½" Three Position 4-way Air Pilot Operated 2000 p.s.i. Valve for Oil or Water Service. Other Designs to 5000 p.s.i. Control Circuit Diagram Below Shows Automatic Return to Mid Position.



More startling HUNT designs to come!

40 YEARS 1919 1959 of Service

HUNT

Quick-As-Wink® AIR AND HYDRAULIC CONTROL *Valves*

Manufactured by HUNT VALVE COMPANY, 2072 East Pershing St., Salem Ohio

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MAY 1959
Vol. 6—No. 5

AUTOMATION®

A PENTON PUBLICATION

The Magazine of Automatic Manufacturing Operations

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automation outlook

MANAGEMENT APPROACH

". . . present profits for small and medium sized companies are not adequate to sustain the necessary growth in an expanding market. But small businesses do not have ready access to low cost capital—they must earn their capital needs. What, then, can smaller businesses do to increase their earnings and bring them more into line with the percentage earnings on sales realized by larger companies? The answer: Small and medium sized companies can borrow large businesses' management approach to automation. . ."—*James R. Sebastian, president, Rapids-Standard Co., see page 58.*

RULE OF THUMB

" . . refining is a science, but it is an extremely delicate one. Operating conditions must be held within strict limits to produce products of desired quality and quantity specifications. This fact underlines the importance of selecting a control system capable of fast response and extreme accuracy. A rule of thumb indicates that a 30,000 barrel per day refinery can afford to invest a quarter of a million dollars in controls alone if the system efficiency can be increased only one-half of one per cent. . ."—*Robert E. Urban, engineer, Procon Inc., see page 92.*

BLACK BOX PHILOSOPHY

" . . any task that a 'black box' can do cheaper and/or better than a man is no fit task for a human being to be doing. Both national survival and human dignity demand that human efforts be directed to tasks that are above and beyond the abilities of 'black boxes.' Efforts toward automation result, almost always, in applying a 'black box' or a 'brass brain' to a task that is beneath a man's dignity. The result is simultaneous improvement of average level of human attainment, increased average wage levels, and reduced average costs of production. . ."—*John C. Kneiling, Office of Theodore J. Kauffeld, consulting engineer, New York, N. Y.*

ADAPTING TO NEEDS

". . . large volume warehousing can already visualize the possibility of automatic warehousing just as manufacturers can approach the automatic factory. However, in the final analysis, the actual need is the most economical long range method of supplying the ultimate consumer from the warehouse facility. Included in economy in its broadest sense are swiftness, safety, and quality protection of the product. And the extensiveness of automatics must always be judged by these factors. . ."—*Jervis C. Webb, president, Jervis B. Webb Co.*

NEW INDUSTRIAL TOOLS

". . . there is absolutely no question but that the future of solid state devices in industrial equipment is an extremely bright one. . . the incorporation of logical functions in transistors will offer an almost unprecedented opportunity to engineers in the industrial equipment field to design and market products which will have far greater utility and application than anyone would have dreamed being possible a few years ago. Following close on the heels of transistors will be a similar pattern in technologies such as thin film, cryogenics, and magnetics. Combined, their usefulness to the industrial world will surprise even the most imaginative of us. . ."—*W. W. McDowell, vice president, Research and Engineering, International Business Machines Corp.*

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BPA NBP

. . . Fluid Power news

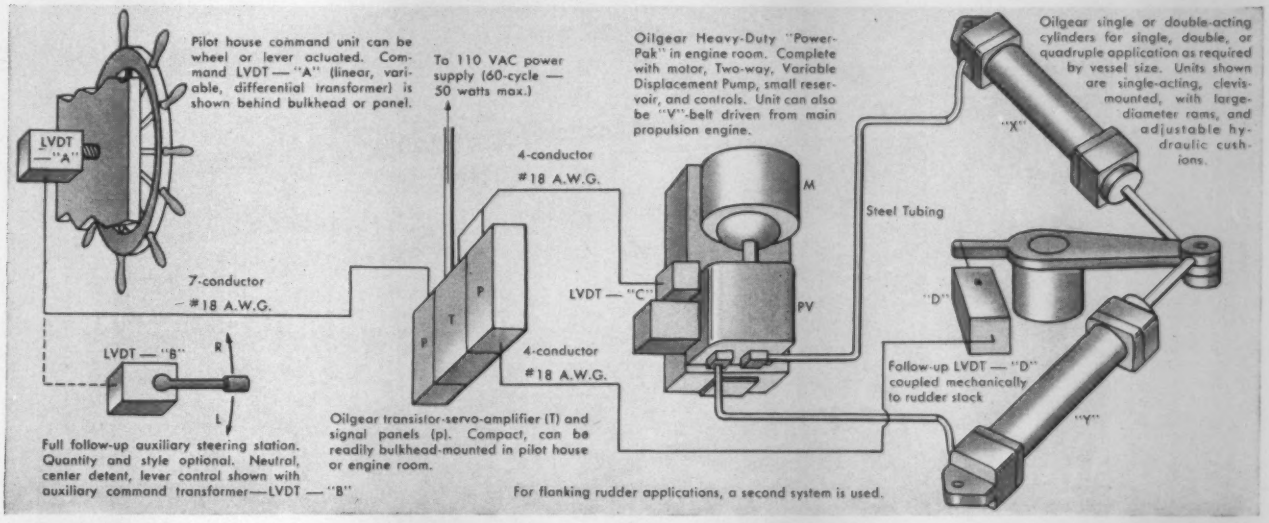
REPORT No. 11,702
NEW MARINE STEERING CONCEPT

From Oilgear Application-Engineering Files

HOW OILGEAR APPLICATION-ENGINEERING AIDED CREATION OF MODERN MARINE STEERING GEAR

CUSTOMER: *A long-established Marine Engineering Company (name on request)*

DATA: This company's technical staff concluded that marine steering gear could be modernized instead of merely being made larger and heavier. A design program to incorporate new electric and hydraulic developments had the following basic objectives. 1: Extreme flexibility for normal application on all vessels requiring power steering. 2: New economy in system weight, size, and installed cost. 3: Simplicity, accuracy, reliability. 4: Full follow-up pilot house and auxiliary station control of rudder movement, speed, position. 5: Eliminate make-and-break, or sliding electrical contacts, relays, vacuum tubes, solenoid valves, heavy shafting, gears, racks, and linkage in the control system. Smooth, positively indexed, rate responsive, stepless rudder movement control that is noise, shock, vibration, and pulsation-free. 7: Compatible with gyro-compass, automatic steering.


Pilot house command unit can be wheel or lever actuated. Command LVDT — "A" (linear, variable, differential transformer) is shown behind bulkhead or panel.
LVDT — "A"
To 110 VAC power supply (60-cycle — 50 watts max.)
Oilgear Heavy-Duty "Power-Pak" in engine room. Complete with motor, Two-way, Variable Displacement Pump, small reservoir, and controls. Unit can also be "V"-belt driven from main propulsion engine.
Oilgear single or double-acting cylinders for single, double, or quadruple application as required by vessel size. Units shown are single-acting, clevis-mounted, with large-diameter rams, and adjustable hydraulic cushions.
4-conductor #18 A.W.G.
7-conductor #18 A.W.G.
LVDT — "C"
M
PV
Steel Tubing
"X"
"D"
"Y"
LVDT — "B"
R
L
P
T
P
4-conductor #18 A.W.G.
Follow-up LVDT — "D" coupled mechanically to rudder stock
Oilgear transistor-servo-amplifier (T) and signal panels (p). Compact, can be readily bulkhead-mounted in pilot house or engine room.
Full follow-up auxiliary steering station. Quantity and style optional. Neutral, center detent, lever control shown with auxiliary command transformer—LVDT — "B"
For flanking rudder applications, a second system is used.

SOLUTION: Above schematic symbolizes an Oilgear Fluid Powered, electrically controlled, marine steering system utilizing the newest electric-hydraulic developments. *Actual installations using this new Oilgear "electro-feedback-hydraulic-servo-control system" have exceeded ALL of the customer's original engineering objectives* . . . proof of Oilgear's cooperation and teamwork to help solve design engineer's problems. Oilgear Heavy-Duty "Power-Paks" are complete, ready-to-install power units in sizes and types to meet every marine need. No auxiliary valves, pumps, controls, reservoirs, or "plumbing" are required. Oilgear "Custom-Quality" single and double-acting cylinders can furnish the "muscle" to control any type vessel. Oilgear ServoControl Division's rugged, compact transistor-servo-amplifier and control system is further proof of Oilgear progressive, pioneering, engineering service. Connections between the amplifier and signal generators can be made by any competent electrician.

In every industry, manufacturers and users recognize and trust the name "Oilgear" for dependable, lowest-cost-per-year operation.

For similar practical solutions to YOUR linear or rotary Controlled-Motion problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

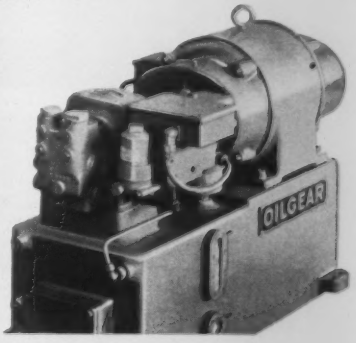
THE OILGEAR COMPANY

Application-Engineered Controlled Motion Systems

1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

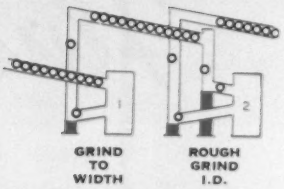
Circle 656 on Page 17

OPERATION: LVDT units (A, B, C, D) are actually coils with a core or slug moved axially in the coil airgap. When core is at central position there is a "null" signal. Maximum signal is emitted at maximum limits of travel — either "in" or "out." Movement of wheel or steering lever displaces core of command LVDT (A or B), producing a signal that is compared in transistor amplifier (T) with the signal from rudder stock coupled LVDT (D). Resulting difference between these two signals is called the "error" signal — built up to usable current strength by amplifier (T). Amplified signal is applied to an AC torque motor on Oilgear Two-way, Variable Displacement Pump (PV), imparting movement in amount and direction as ordered to a hydraulic servo valve — stroking pump (PV) to supply ordered direction and volume to rudder actuating cylinders (X, Y). As rudder moves, coupled LVDT (D) is displaced to reduce error signal to zero — at which point the cycle is complete. During this cycle, pump LVDT (C) has also been sending its signal to the amplifier for comparison, insuring that pump output is always under error signal control. Rapid motion of the command wheel or lever generates a large error signal, resulting in full rudder speed. Similarly, a slow command movement results in a slow rudder speed.



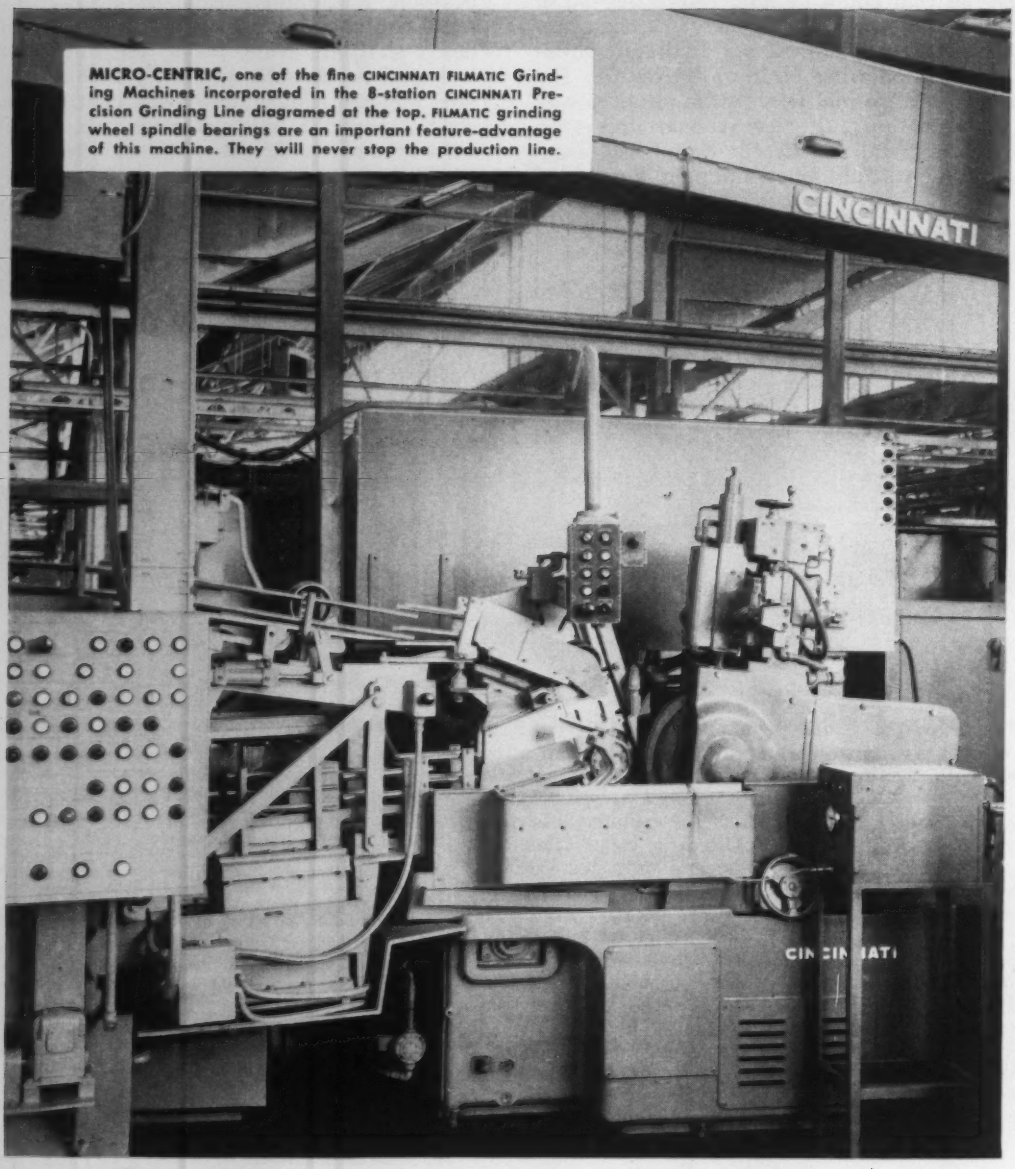
RIGHT: Oilgear Size 3, Heavy-Duty "Power-Pak" with Two-way, Variable Displacement Pump, motor, reservoir and controls . . . "as shipped," ready for installation with an "electro-feedback" system described above. This unit is now in use on a new 144' x 55' x 5' draft ferry boat of 483-ton displacement.

Similar Oilgear Systems are being used to control motion in all industry.



FILMATIC

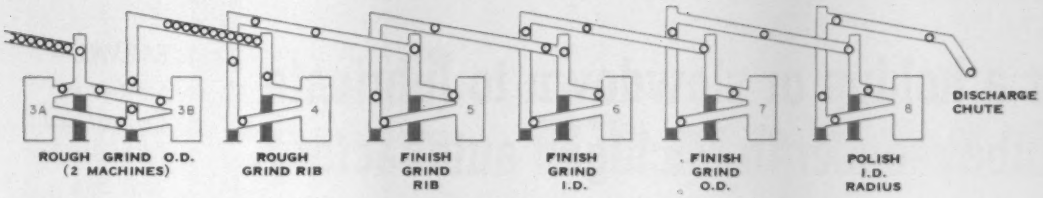
CINCINNATI Builds



MICRO-CENTRIC, one of the fine CINCINNATI FILMATIC Grinding Machines incorporated in the 8-station CINCINNATI Precision Grinding Line diagramed at the top. FILMATIC grinding wheel spindle bearings are an important feature-advantage of this machine. They will never stop the production line.

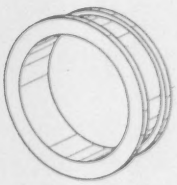
BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO



Precision Grinding Lines...

to keep your costs in line



Anti-friction bearing cone, a high-quality, high-volume component produced at rock-bottom cost on the CINCINNATI engineered and built Precision Grinding Line described here.

Every shop faces the problem of cost control. It's one of the prime reasons for installing production lines to automatically perform different operations, or a series of *similar* operations like the Cincinnati Precision Grinding Line diagramed above. This equipment produces higher quality bearing cones at a lower cost than ever before. The line is an independent unit system, developed by Cincinnati automation specialists. Each unit constitutes an individual and complete machine, which can be replaced whenever conditions change. Although there are machines of other makes in this line, Cincinnati takes complete responsibility for everything: the machines, tooling, conveyors, electrical equipment, quality and production.

Parts rolling off this line conform to the highest standards of precision bearing manufacture. In all, there are seven grinding operations and one polishing operation. Grinding stations incorporate Cincinnati Automatic Sizing with feedback controls and automatic washing and demagnetizing of the parts. A banking arrangement for the first three machines takes care of unforeseen difficulties. The automatic handling equipment accommodates five sizes of bearing cones covering a diameter range of 2 to 1. It requires no adjustment whatever in changing from one size to another.

Cincinnati's forward-thinking engineering staff and extensive manufacturing facilities are tops for developing and building production lines of this type. We invite your inquiries on precision cylindrical grinding equipment of any size ranging from versatile toolroom grinders to completely automatic grinding lines.

CINCINNATI

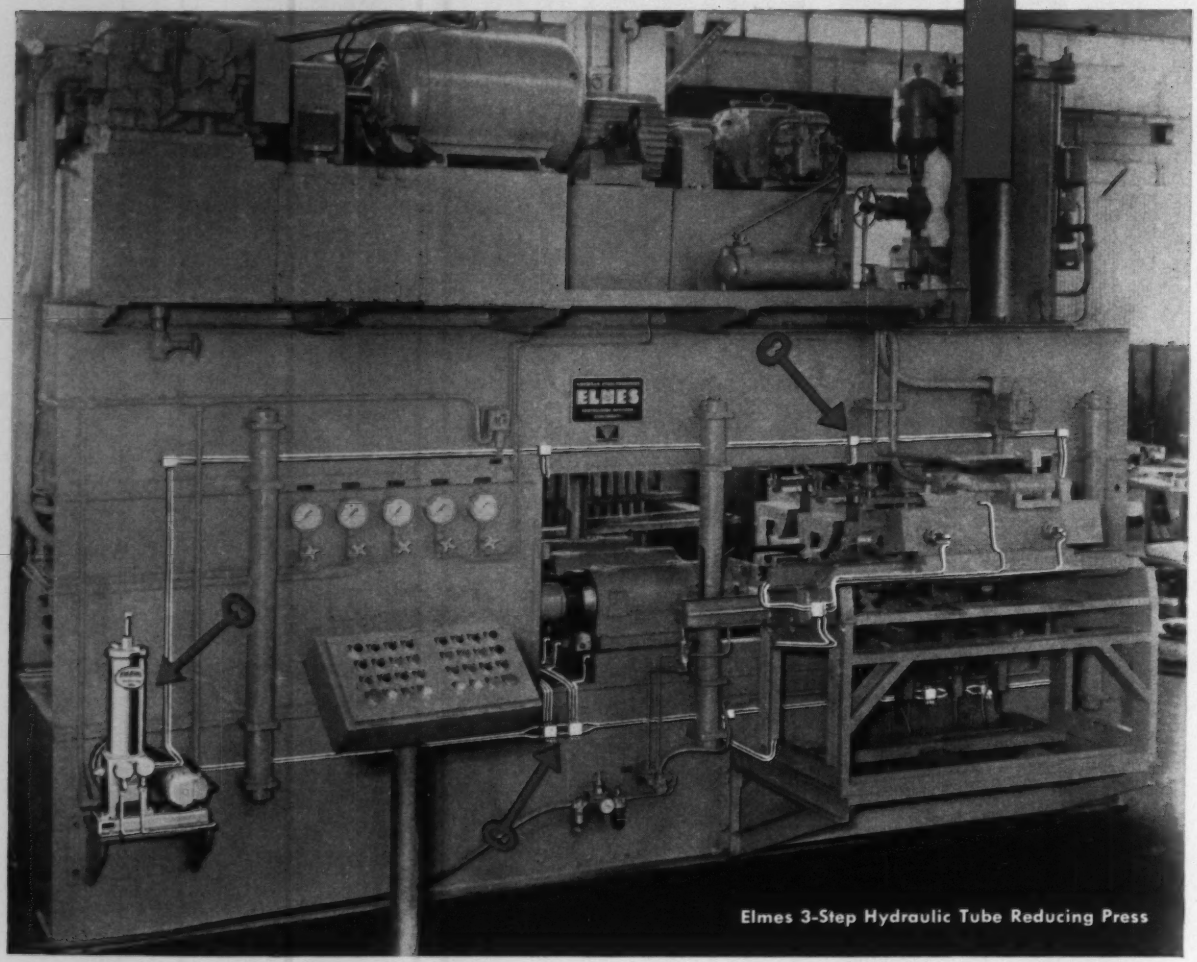
• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

Circle 657 on Page 17

Never a holdup or slowdown to lubricate this tube reducer in Michigan auto factory

FARVAL—
Studies in Centralized Lubrication
No. 203



Elmes 3-Step Hydraulic Tube Reducing Press

● With automation, centralized lubrication is a must. What automated line can afford to slow down or shut down because a forgotten bearing has run dry?

Equipped with Farval, any machine can operate continuously, day and night, with never a pause for lubrication nor a shutdown for a burned-out bearing.

Farval delivers a measured amount of clean oil or grease to every bearing served, at any desired, predetermined interval. No bearing is ever missed—and the amount of lubricant delivered to any one bearing can be varied without affecting the rest of the system. Guesswork and hit-and-miss hand oiling are eliminated with Farval.

A Farval Centralized Lubrication System, manual or automatic, is easily designed into any machine. Let us send a representative to discuss application of Farval to your equipment. Drop us a line. Also ask for Bulletin 26-S. The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio. ®Reg. U.S. Pat. Off.

Affiliate of The Cleveland Worm & Gear Company
(Subsidiary of Eaton Manufacturing Company)

KEYS TO ADEQUATE LUBRICATION—

Wherever you see the sign of Farval—the familiar central pumping station, dual lubricant lines and valve manifolds—you know a machine is being properly lubricated.

This *Farvalized* machine is an Elmes 60-ton Tube Reducer. In three steps it reduces tubing for drive shafts for a well-known Michigan-made automobile.

Circle 658 on Page 17

AUTOMATION news

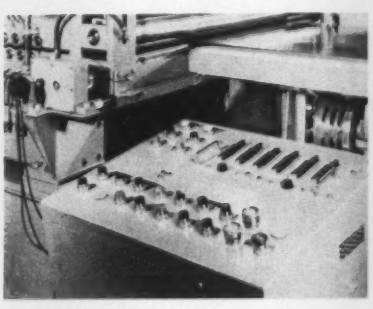
Today's events and developments in the field of automation

Programmed Controller Directs Continuous Shear Line

FLEXIBILITY, accuracy, and high production are desirable design characteristics for automatic machine lines, but usually one or more of these features must be compromised in order to attain another. This is not the case of a new die shear line developed by McKay Machine Co. All three of the characteristics, plus an additional one of compactness, have been built into the versatile line.

The McKaymatic die shear lines are designed for high production output of variable-length flat sheets from coiled stock. Whether cutting a large tonnage of the same size sheet or small lots of odd-length sheets, the shear lines continue to run at the same speed. Flexibility is offered by electronic control which makes changing of length of cut an instantaneous operation. When length and quantity commands are changed, either manually or automatically, the line reacts accordingly without slowing down or stopping.

The shear line consists of a payoff reel, a roller leveler, a traveling die cut-off press, and a console for controlling the system and changing the length of cut. Depending upon the type of use, the length of cut can be controlled manually by pushbutton settings or by automatic programming equipment using punched cards or punched tape.



ALL OPERATIONS of die shear line are controlled from this console. Pushbutton setup allows instantaneous change of die cutting length. Punched card or tape automatic programming equipment is available as optional equipment.

DIE SHEAR LINE developed by McKay Machine Co. features electronic control which makes the changing of the length of cut an instantaneous operation. Unit shown handles 48-inch wide sheets with a maximum thickness of 10 gage. Coiled stock feeds through a 17-roll backed-up leveler which flattens the material. Traveling die in cut-off press on right accelerates to line speed, cuts, and returns automatically to home position. Length of cut sheets can be changed while machine is operating by inserting new length signal into pushbutton setup in control console.

The heart of the shear line is a traveling die cut-off press which precludes any strip damage normally associated with mechanical length gaging. During each cutting cycle, the traveling die set accelerates to line speed of about 200 feet per minute when cutting sheet lengths of 4 feet or over, cuts, and returns to its starting position. In addition to standard cut-off blades, the die set can also incorporate notching and piercing tools when these operations are located near the shear cut.

Accuracy of the shear cut at the high speeds is controlled by a surface measurement system actuated by the exit pinch rolls of the leveler unit. For each full turn of the bottom pinch roll, a pulse generator feeds 500 pulses to an electronic counter in the control console. In this manner, length measurements of sheared sheets are controlled to an accuracy of 0.01 inch. When using the manual pushbutton system of control, the operator can insert any length of cut command while the machine is operating at full speed, and the shear line will accurately measure and cut the next sheet to the desired length.

For simplicity of maintenance, ac drive motors and controls are used, in conjunction with a mechanical speed variator. No speed matching of line components is necessary. The exact design and dimensions of the various components in the shear line can be varied, depending upon the customer's requirements and the size of strip to be handled. Patents are

pending on the various new applications of concepts used in the line.

Novel Electric Motor Uses Printed Circuits

DEVELOPMENT of a printed circuit electric motor (or generator) was announced by **R. Page Burr**, president of Circuit Research Co., at the recent convention of the American Institute of Electrical Engineers. In the new motor, the cylindrical wire windings of the conventional motor are replaced by flat, disc-like printed coils. Rather than a cylindrical shape, the printed circuit motor has a flat pancake shape and is generally constructed so that only the light-weight printed circuit revolves.

Potential economies of the new technique are great, according to Mr. Burr who pointed out that the armature of a 25 horsepower dc printed circuit motor would measure 15 inches in diameter and would cost less than $50 as opposed to several hundred dollars for a conventionally wound part. He stated that smaller versions of the same type motor exceed the performance of any device now available for instrument and automation applications.

The new motor is the result of a development program by three U. S. companies working with the French inventors, **J. Henry-Baudot** and **F. H. Raymond.** Printed Motors Inc. brought the invention to this country from France and will make the motor inventions and know-how available to U. S. manufacturers on a licensing basis. Electrochemical and printing techniques required to make the device commercially practical were perfected by Photocircuits Corp. Electrical and electronic developments on the motor have been done by Circuit Research Co.

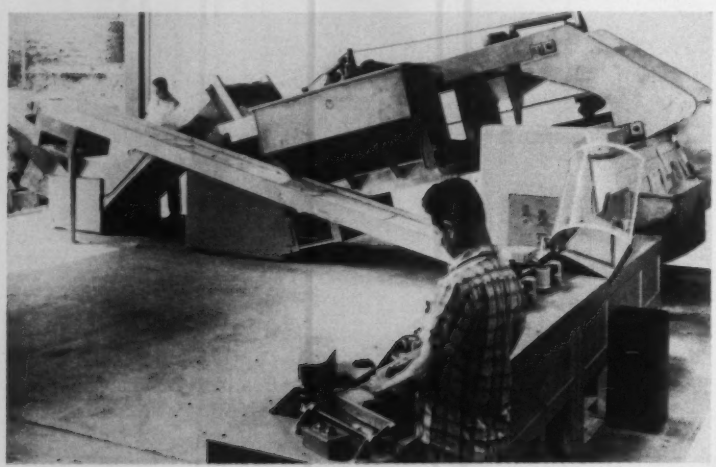
Electronic Tracer-Cutter Uses Photographic Image Template

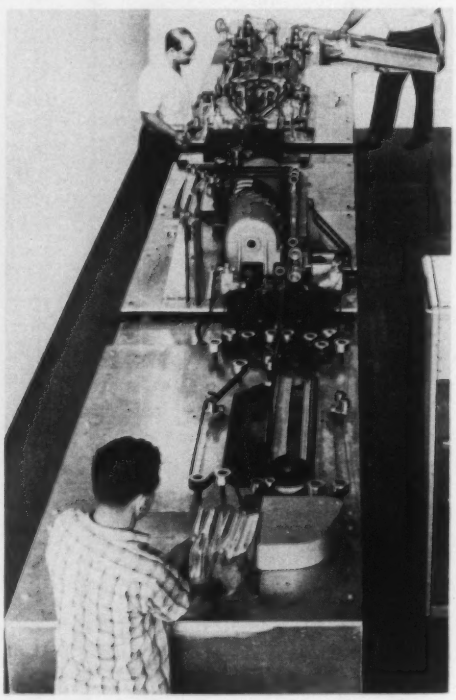
AUTOMATIC flame plate-cutting machine designed primarily for shipyard use is being built by National Cylinder Gas Div., Chemetron Corp. The new electronically controlled tracing and cutting machine is expected to provide substantial savings in the cost of preparing patterns and cutting large steel plates used in ship construction.

The automatic machine will use a new principle of electronic tracing which was developed by Canadian Westinghouse Ltd. The image to be cut is projected on a ground-glass plate from a 4 by 5 inch photographic negative containing all the template information. An electronic centerline follower traces the photographic image and controls equipment for cutting steel plates which can be 10 by 50 feet or larger. Completion of the first unit is scheduled for June, 1959.

Plant and Equipment Spending Key to Continued Economy Gain

RECORD for the first quarter of the year is generally good, apart from the sluggish conditions which prevailed in labor markets, according to the latest review of current economic conditions by the Guaranty Trust Co. of New York. Both gross national product and industrial production registered satisfactory gains. The combination of high consumer spending, resumption of inventory accumulation,





AUTOMATIC equipment for handling letter mail has been delivered by the American Machine & Foundry Co. to the U. S. Post Office Dept. for testing. After being dumped into a hopper of the mail culling machine, left picture, bulk mail traverses a series of inclined conveyor belts from which parcels, thick envelopes, and tied bundles of letters are diverted into side bins. Single pieces of mail then pass to subsequent stations where oversized pieces are removed from the stream. The culled letters are stacked and transferred to the automatic facing machine, right picture. As the letters feed into the machine one at a time, they are scanned photoelectrically to locate the stamp. Properly oriented letters go directly to a cancelling station while letters with stamps out of position are directed through an inverting mechanism. At final station, all letters are stacked for subsequent processing. The machine automatically rejects letters without stamps. The equipment has been installed in the Postal Laboratory, Washington, D. C.

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QUALITY MOTOR CONTROL

Circle 659 on Page 17

strength in residential construction, and a turnabout in plant and equipment outlays pushed GNP to an annual rate of about $464 billion in the first quarter which is about $11 billion above the annual rate experienced in the last quarter of 1958.

A further increase in GNP seems virtually certain for the second quarter of this year. In the business sector, an increase in plant and equipment outlays during the second quarter is indicated by the latest Government survey data, and there seems to be a good possibility of a further advance in the rate of inventory accumulation. The recovery movement has not as yet produced any demonstrable distortions or excesses in the economy. So long as this remains evident, there will be prospects for continuing gains, since in a healthy environment each new phase of expansion—accompanied as it is by a higher flow of payments—tends to beget still more expansion.

Discussion Groups Highlight Automation Conference

HIGHLY SUCCESSFUL Third Conference on Manufacturing Automation was held at Purdue University, Lafayette, Ind. Co-sponsored by the Schools of Mechanical Engineering and Industrial Engineering of Purdue University and the editors of AUTOMATION, the conference sessions covered the broad aspects of organization and costs relating to automation and presented in depth various subjects on work performing, handling in process, and control of operations. Not merely an educational meeting confined to formal presentations, the conference attained its greatest value in bringing together top experts from industry with individual conferees in the informal discussion meetings after each session.

INFORMAL discussion meetings attracted great interest. Robert A. Lowe, managing partner, R. A. Lowe & Co. (facing camera), answered questions on cost analysis and machine replacement, subject of his conference presentation.

PRODUCTIVITY and its effect on the economy of the nation was the topic presented at the conference banquet. Roger W. Bolz, editor of *AUTOMATION*; banquet speaker Leon Greenberg, U. S. Dept. of Labor; and toastmaster John A. Ritchey, assoc. prof. at Purdue University are shown left to right.

COMPUTER control of production processes was discussed by Dr. Joseph F. Manildi, general manager, Thompson-Ramo-Wooldridge Products Co., at one of the general conference sessions.

DISCUSSION group led by Alfred Johnson, IBM Corp. (second from right), gets a close-up view of standardized components used in computer construction.

CONFEREES see demonstration of a high-speed press during tour of Purdue University machine shops.

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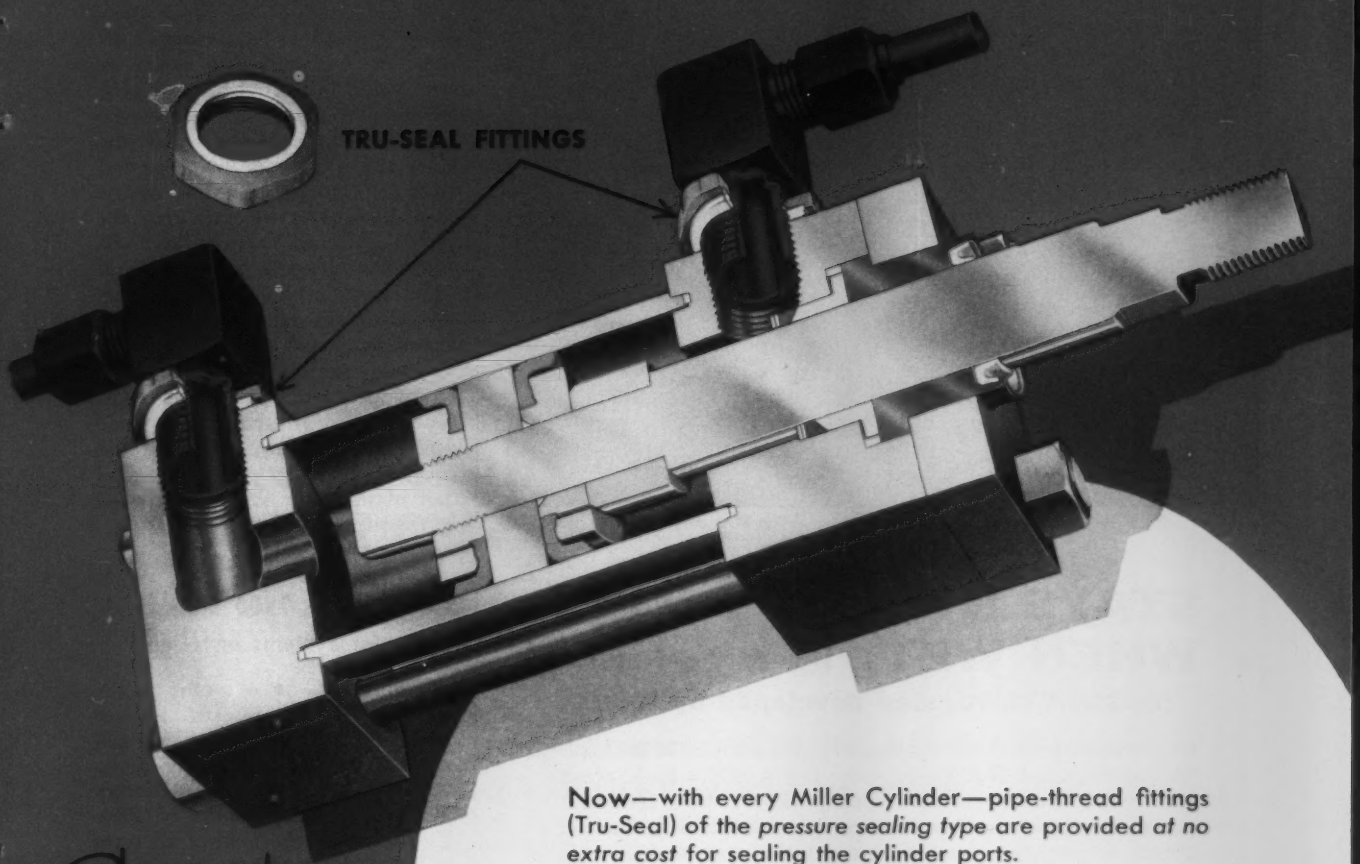

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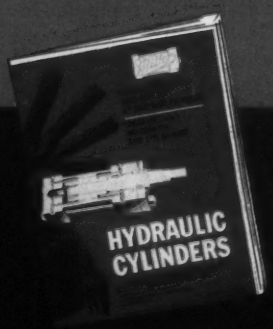

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Circle 660 on Page 17

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Given present tendencies, it does not seem unreasonable to expect a gain in GNP during the second quarter of about $7 to $9 billion at an annual rate. What will happen after the second quarter is a much more speculative matter, with the answer depending in considerable part on how prospects are viewed for plant and equipment expenditures.

If the results of the latest Government survey of businessmen's investment intentions are taken at face value, plant and equipment spending in the second half of the year will approximate about the same annual rate as in the second quarter. This prospect has caused some analysts to conclude that the general business pattern may be somewhat sluggish in the second half. However, since previous survey intentions, published after other recessions, have had a downward bias and because of the improving profits situation, it seems very possible that there may be a good deal more strength in plant and equipment spending in the second half of this year than is indicated by the survey data.

Survey Shows 7200 Digital Computer Systems Installed

ACCORDING to a recent survey conducted by the research staff of John Diebold & Associates Inc., 624 general-purpose electronic computers were installed in this country in the last nine months of 1958. This increases the total of all types of installed digital computers to approximately 7200, an increase of 1200 over the 6000 systems in operation in March 1958.

Classification of computers now presents certain problems because of the wide range of optional equipment which can be included in systems. However, by establishing certain minimum requirements, the survey has divided the computer installations into four classifications and estimated the total number of computers that fall into each classification. According to the survey, 316 large-scale general purpose digital computer systems have been delivered. Systems under this classification use magnetic tapes and operate at microsecond arithmetic speeds. Medium-scale systems use

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Circle 662 on Page 17

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405	445	485	525	565	605	645	685	725	765	805
406	446	486	526	566	606	646	686	726	766	806
407	447	487	527	567	607	647	687	727	767	807
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411	451	491	531	571	611	651	691	731	771	811
412	452	492	532	572	612	652	692	732	772	812
413	453	493	533	573	613	653	693	733	773	813
414	454	494	534	574	614	654	694	734	774	814
415	455	495	535	575	615	655	695	735	775	815
416	456	496	536	576	616	656	696	736	776	816
417	457	497	537	577	617	657	697	737	777	817
418	458	498	538	578	618	658	698	738	778	818
419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
431	471	511	551	591	631	671	711	751	791	831
432	472	512	552	592	632	672	712	752	792	832
433	473	513	553	593	633	673	713	753	793	833
434	474	514	554	594	634	674	714	754	794	834
435	475	515	555	595	635	675	715	755	795	835
436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	759	799	839
440	480	520	560	600	640	680	720	760	800	840

AUTOMATION . **May, 1959**

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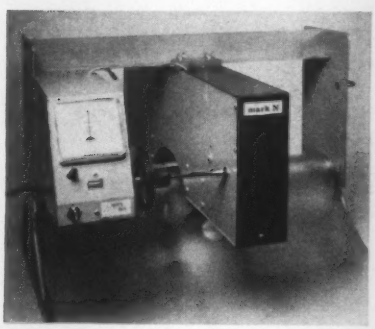
magnetic tapes and operate at millisecond arithmetic speeds. Under this classification, approximately 348 computer systems have been installed.

A third classification, small-scale systems, includes computers which do not use magnetic tapes and are internally programmed. Approximately 1370 systems have been delivered in this classification. The last classification totals approximately 5166 delivered units and includes miscellaneous digital computers which are card calculators and other installations that do not fall in the first three classifications.

Multiform Glass Developed

PRESSED and sintered glass that can be hermetically fused to 446 stainless steel has been developed by Corning Glass Works. Called Multiform glass, the new material is made from minute glass particles that are pressed to shape and fired at high temperatures. The particles are consolidated by fusion into a nonporous, vacuum-tight structure.

The process permits intricate shapes, holes, and small radii to be formed economically in glass. The parts made with the new glass retain the thermal endurance, corrosion resistance, and dielectric strength of the parent glass.



ELECTRONIC-OPTICAL instrument developed by Mark N Laboratory measures the thickness of sheet, foil, or webbing material of any kind. Physical properties of the material—such as dielectric constant, conductivity, absorption—are not involved in the measurement. The gage is noncontacting, clears the material by one inch or more, and is unaffected by surface speed of material. As material flows under the gage, a meter indicates variations from nominal thickness. Output of the gage can also be used to actuate signal devices, to operate chart recorders, or to control thickness or coating weight in manufacturing operations.

AUTOMATION NEWS FEATURE

Equipment Leasing Grows

IN DECEMBER 1958 there was approximately $227 million worth of production equipment on long-term lease throughout U. S. industry. In dollar volume this represented a 26 per cent gain over a period of 12 months. This special report on equipment leasing will answer many questions on this method of obtaining the use of income-producing equipment without capital investment.

By ROBERT SHERIDAN, President
Nationwide Leasing Co.
Chicago, Ill.

EQUIPMENT LEASING has increased as a result of the steadily increasing cost of capital equipment. Historically, leasing has been a means of permitting businessmen to function without owning everything they need to do business, since profits are made by *using* capital equipment, rather than by *owning* it.

Equipment leasing is a long-term arrangement, normally from 3 to 10 years, although in some cases it may be as little as 2 years or as long as 15 years. It is different from equipment rental which is a short-term affair. The rental firm rents out new or used pieces for a brief period, reclaims them at the end of the period, and then rents the equipment to other users. Leased equipment remains the property of the leasing company and is used by the lessee who pays the leasing company a fixed charge for a stated period for using the equipment.

All types of companies in virtually every industry are leasing equipment. According to our annual surveys, the 10 leading industries using leased equipment in 1958 included: Aircraft and parts, chemicals and drugs, construction and road-building, electrical equipment and machinery, fabricated metal products, food products, petroleum refining, printing and publishing, pulp and paper, and the supermarket industry—the first nonmanufacturing industry to be ranked among the top 10 users of leased equipment.

Leased equipment can be broken down into three major uses—office equipment, production equipment, and warehousing and storage equipment. Insofar as office equipment is concerned, leasing has gained its greatest acceptance in the data processing field, ranging from office duplicators to analog computers. Since most businesses consider office costs as a nonproductive overhead factor, they are reluctant to use liquid working capital to introduce equipment improvement there. Leasing has proved to be attractive for this area, and a number of data processing equipment manufacturers have developed leasing plans in conjunction with leasing companies.

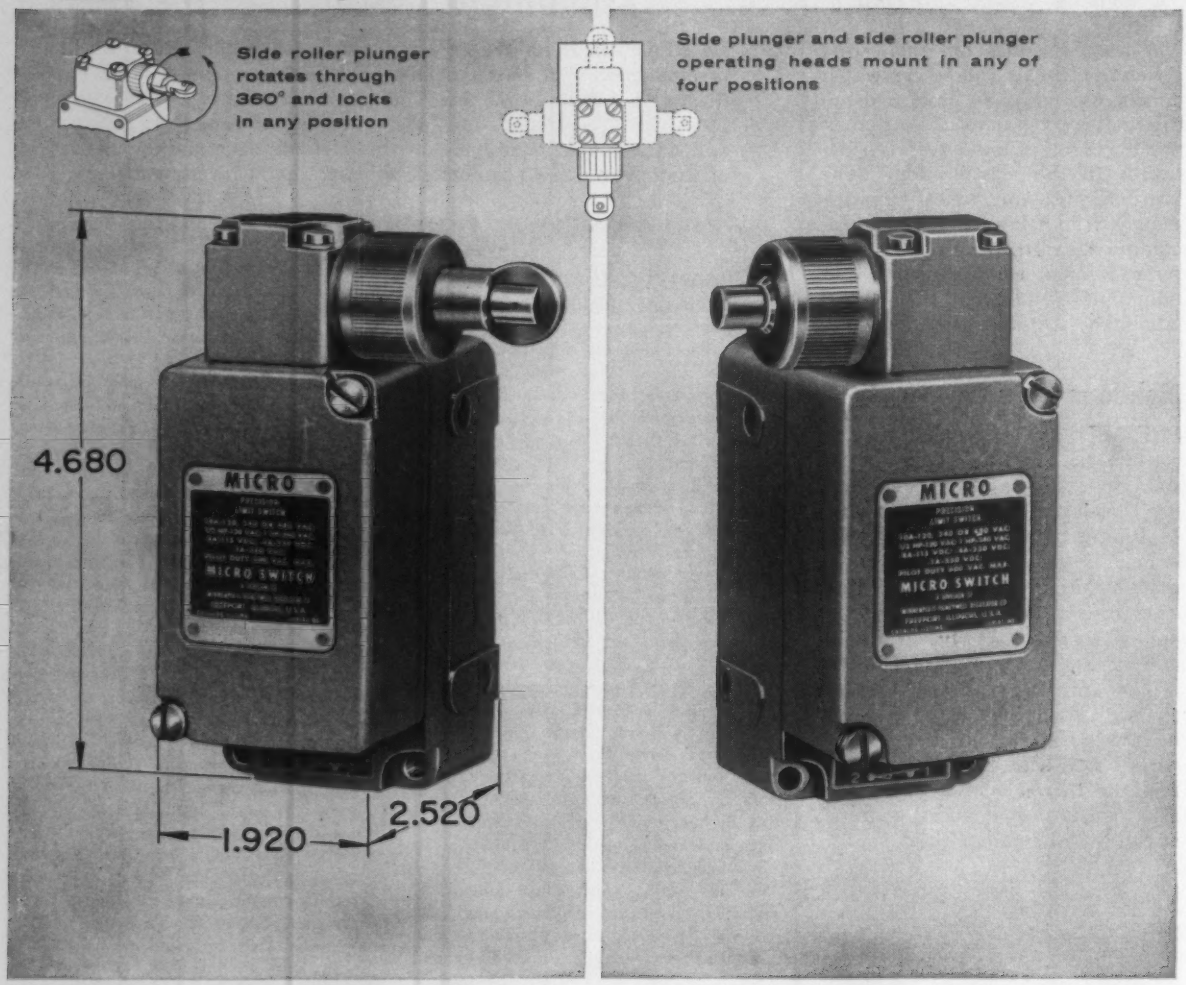
The bulk of leased production equipment is for the purpose of modernizing production methods and reducing costs. This area is the backbone of the equipment leasing industry due to the high cost of new equipment, the tightness of working capital, and unrealistic government depreciation schedules. Some of the types of production equipment leased are cutting, boring, pressing, stamping, molding, packaging, sealing, labelling, and wrapping machines.

Leasing of equipment used in warehousing and storage is on the increase and is normally included in master leases involving production equipment. Warehousing organizations themselves have used equipment leasing primarily through sale-leaseback transactions. A number of department stores have leased conveyor systems and other materials handling equipment for their warehouses. While volume in this area has not been large, it has been growing in the last two years.

What is the procedure for securing leased equipment? First, a company submits an application describing itself, its business, and its financial position. It lists the specific manufacturer from whom it wishes to secure the equipment, the price of the equipment, the length of lease terms desired, and the form of payment desired. Upon approval of the application, the leasing company then purchases the equipment and arranges for its shipment directly to the lessee's plant. Payments start upon acceptance of the equipment. All equipment, no matter how many items are involved, can be covered by a single master lease and be paid for in a single monthly payment, regardless of how many suppliers are involved.

In a number of industries, leasing programs have proved to be an effective method of increasing sales, through offering customers the option of purchase or lease. Under these programs the leasing company assumes the lease contract and pays the manufacturer in full when the equipment is delivered. The customer has the benefit of the lease, and manufacturer has a cash sale. Not only does this normally enable a manufacturer to increase his sales by the added leasing volume, but the interest generated around the leasing plan opens new markets for the product and results in increased direct sales, often greater than the leasing volume.

Manufacturers of automated equipment in the office machinery field have been in the forefront of using leasing as a sales tool and have found it effective for their purposes. However, manufacturers of production equipment have



New 203LS1 "Plug-in Limit" switch with side roller plunger actuator

New 204LS1 "Plug-in Limit" switch with side plunger actuator

Two new switches added to sealed "Plug-in Limit" line

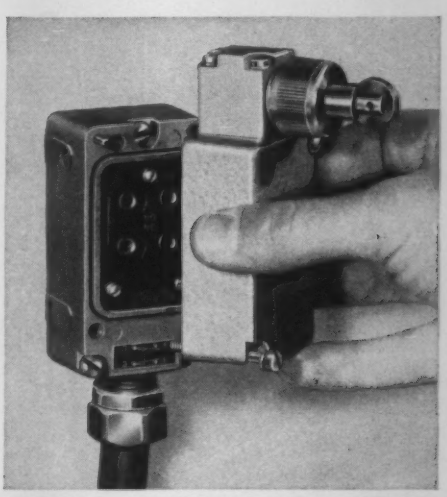
The addition of these two new switches greatly increases the usefulness of the pace-setting "Plug-in Limit" line. Like the other "200LS" switches, they are rugged, reliable, compact, and completely sealed against oil, water, dirt and dust.

These new units also share the quick-change plug-in feature, as illustrated and described at upper right, which virtually eliminates downtime and gives unmatched versatility of machine control.

"Plug-in Limit" switches are two-circuit double-throw. Electrical rating is 10 amps., 120, 240, 480 vac; ½ H.P. 120 vac; 1 H.P. 240 vac; 0.8 amp. 115 vdc; 0.4 amp. 230 vdc; 0.1 amp. 550 vdc. Pilot duty rating is 600 vac max. They meet NEMA Industrial Control Standards.

See the Yellow Pages for nearby distributors and MICRO SWITCH branch offices. For details on 58 different limit switches, send for Catalog 84.

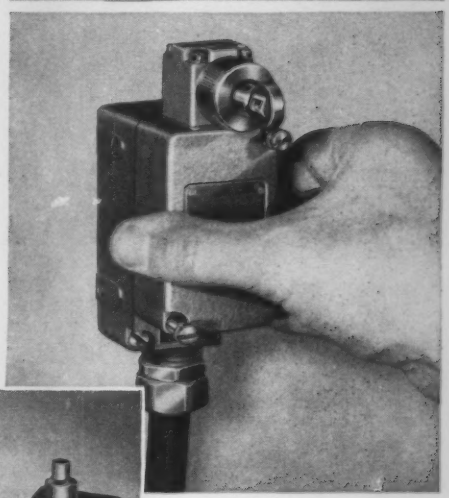
PULL OUT



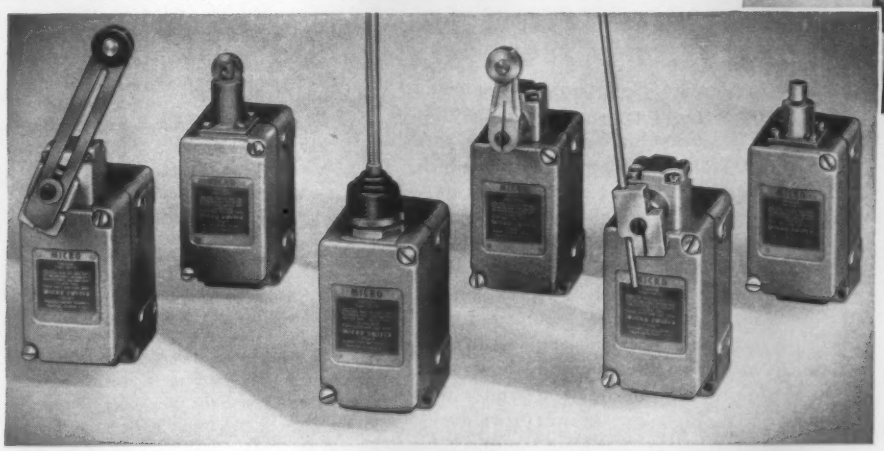
You can replace or interchange a "Plug-in Limit" switch in 20 seconds

A "Plug-in Limit" switch plugs into the terminal enclosure like a radio tube and is secured by two No. 10 screws. Together, the two parts form a sealed assembly. All eight switches in this series use the same terminal enclosure—18PA1. A switch can be replaced or control arrangement changed in as little as 20 seconds.

PLUG IN



With the two new switches, the "200LS" series is now available in 8 different types to meet an even wider range of industry needs. The six others are, left to right: 201LS3 adjustable arm rotary actuator; 205LS1, roller plunger actuator; 208LS1, coil spring actuator; 201LS1 roller arm actuator; 201LS10, rod actuator; 202LS1 push plunger actuator.



MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

Circle 664 on Page 17

EMCOR®* Pre-engineered cabinets give erector-set versatility to industrial needs

From a single unit to a complete control center . . . EMCOR Standard Cabinets answer your housing problem. Shown above, closed circuit TV in Southern Railway System's Modern Yards "pick" car numbers from inbound trains.

Central nerve center of the new Diana Stores Corporation, New York City, automation warehouse system is a single EMCOR Cabinet. The operator dials incoming cartons into the electronic control system which directs the merchandise to its proper destination on the building's third, fourth or fifth floor. Standard stock frames of the EMCOR MODULAR ENCLOSURE SYSTEM provide design flexibility . . . provision for expansion or exchange of equipment, and custom features in each pre-engineered cabinet. Advanced engineering know-how meets today's electronic packaging demands with years ahead planning. Answer your enclosure problem easily . . . from the complete EMCOR line of pre-engineered cabinets and components.

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Originators of the Modular Enclosure System

QUALITY EMCOR PRODUCTS

ELGIN METALFORMERS CORP.

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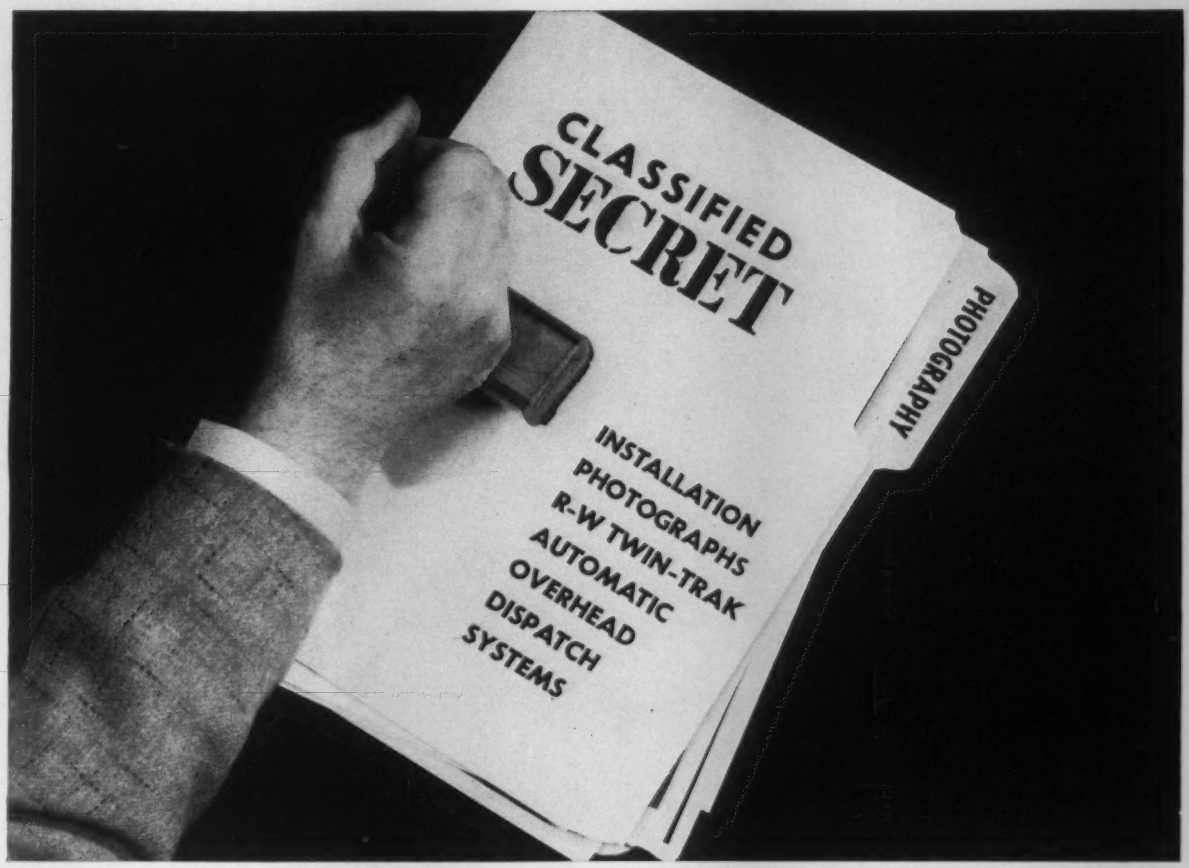
been slower to recognize the value of leasing plans for their industries. The major stumbling block in this area has been the reluctance of manufacturers to become involved in a variety of financing plans. The entry of leasing companies into the picture offers manufacturers a way to promote leasing of their equipment without being encumbered by massive financing and paperwork problems.

Leasing provides a company with greater cash flow than any other financing method. As a result, the relative cost of leasing is less than other financing methods. Any expenditure of money to acquire equipment involves paying something for the use of the money. Even in the case of outright cash purchase, a manufacturer is sacrificing the earnings that his working cash would yield. Thus, in effect, he is paying for the use of his own money. Before-tax profits on net working capital in manufacturing industry range from 20 to 92 per cent, with a median point of 39 per cent. This is what working capital earns, and, therefore, is the "cost" of using working capital to buy fixed assets.

When equipment is leased rather than purchased, the "cost" of the equipment can continue to be used as working capital and earn profits for the company at the company's normal rate for the life of the lease. The before-tax profits of 20 to 92 per cent on this additional working capital can be so great that the relative cost of leasing will be lower than other financing methods.

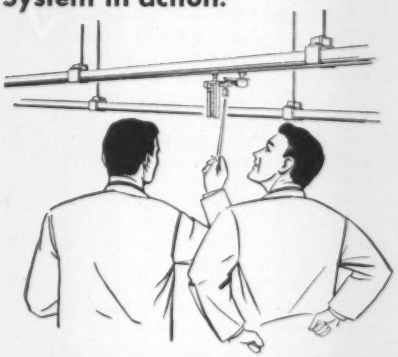
Recent new trends in leasing are the sale-leaseback transaction (commonly, but erroneously, termed purchase-leaseback) and merchandising-leasing plans involving the co-operation of equipment manufacturers and a leasing company to increase sales. In the sale-leaseback transaction, a company builds a new plant, sells the equipment and facilities to a leasing company as soon as it is completed, and immediately leases it back. This is also done with older plants. This method enables firms, whose financial ratios would not otherwise permit them to expand at a great rate, to do so without straining their capital structure.

One question often asked is, "Can leasing agreements contain purchase options?" The answer is yes, but it is not a recommended procedure. A purchase option generally converts a leasing agreement into a conditional sales contract, in the eyes of the Internal Revenue Dept. There are some exceptions to this general rule, but these exceptions are uncertain and depend on specific rulings by the Internal Revenue Dept. at the conclusion of the contract, many years later. True lease payments, as differentiated from disguised conditional sales contract payments, are legitimate deductions as operating expenses. Conditional sales contracts are deductible only at a rate specified in government depreciation schedules.



SO GOOD WE CAN'T SHOW INSTALLATION PHOTOS

See an actual R-W "TWIN-TRAK" Automatic Overhead Dispatch System in action.



A complete and operating R-W "TWIN-TRAK" Automatic Dispatch System will be on display at the Material Handling Institute's Exposition of 1959, June 9-12. You are cordially invited to visit us in Booth 1414 on the lower level of the Cleveland Public Auditorium.

. . . unbelievable, maybe — but so true. Manufacturers who have installed an R-W "TWIN-TRAK" Automatic Dispatch System have found that this unique system not only improves materials handling, but, because of its great versatility, permits the coordinated use of special new production techniques and machines to produce products faster and more economically. It is because of these special innovations that we cannot show installation photographs.

R-W "TWIN-TRAK" Automatic Dispatch Systems consist of one or more power tracks and as many storage or free tracks as desired, plus the necessary switches, carriers and power equipment. R-W "TWIN-TRAK" Systems not only move products from one point to another, but automatically and economically convey parts or products to predetermined work stations from "storage or inventory banks" installed in the free overhead areas under the building trusses. R-W "TWIN-TRAK" Systems are economical to install, operate and maintain. They not only reduce operating and overhead costs and increase production efficiency but can actually pay for themselves out of actual savings in a relatively short period of time. Write today for complete information.

"TWIN-TRAK" is the trade-mark of Richards-Wilcox Mfg. Co., identifying its Automatic Dispatch System.

R W

Richards-Wilcox

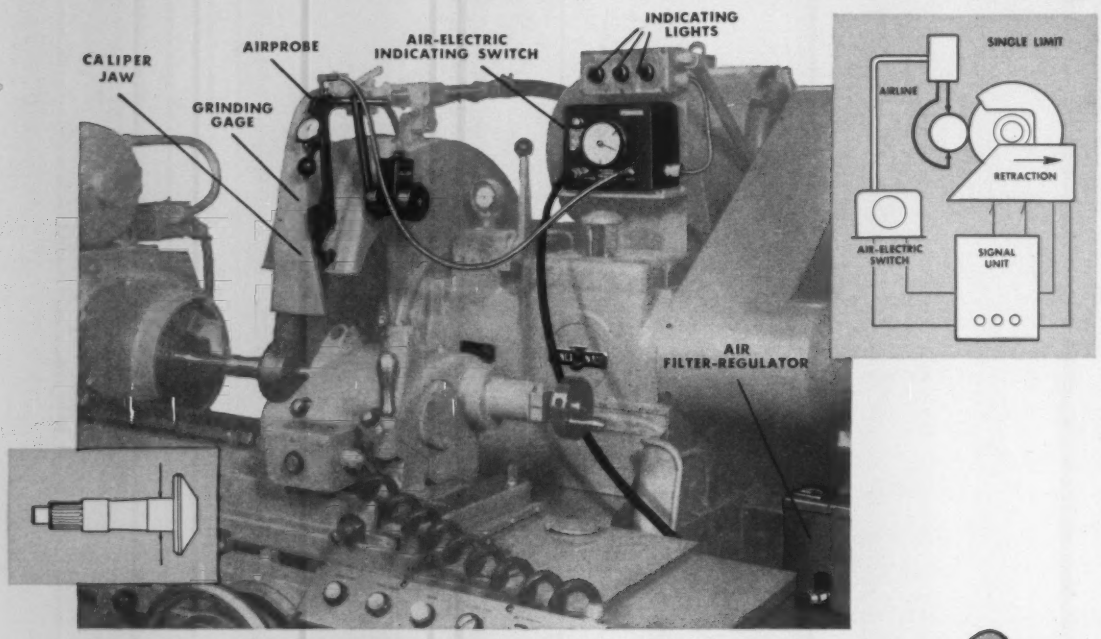
MANUFACTURING COMPANY

"MATERIAL HANDLING DIVISION"

417 W. THIRD ST. • AURORA, ILL. • Branches in all Principal Cities

Circle 666 on Page 17

CONTROL FINISH SIZE *Automatically! Economically!*



Automatic Control Gaging improves your grinding operation 3 ways . . .

1 It controls on the basis of finish size *only*, thus overcoming the disadvantages of timed cycle or fixed stop grinding. Wheel wear, O.D. variation in work to be ground, "give" in many of the machine elements, and flexing of the work, no longer affect accuracy and piece-to-piece uniformity of the finished part.

2 It controls *automatically*, thus you eliminate any errors caused by operator fatigue, inexperience, or inattention. The Federal automatic control gage never tires, will hold part size to .0001" or better on a good machine, and is easily adjusted to control different sizes of work. Its air-electric system overlooks minor surface irregularities which confuse size readings of other gages.

3 Automatic control gaging makes it possible for one operator to handle two grinders performing the same or different operations. Here's an actual case history of direct labor cost savings:

	MEN	MACHINES	COST PER PIECE	PRODUCTION RATE pieces per 8 hr. shift
BEFORE			$.03585	1344
CONTROL GAGING INSTALLED				
AFTER			$.01526	1386

SAVINGS (per piece) . . . . . $.02059
RATE INCREASE (per shift) 42
TOTAL SAVINGS (per shift) $28.59
EQUIPMENT COST AMORTIZED — 60 DAYS

HOW IT WORKS

The Federal automatic control gage measures the work continuously *as metal is being removed* and automatically retracts the wheel the instant finish size is reached.

EASY TO INSTALL

This standardized Automatic Control Gage (Model 133M-103 illustrated) is stocked for speedy delivery. Only a few components to install. Easily applied to any plain grinder having hydraulic wheel slide. Can also be used in connection with wheel slide stop to *additionally* provide spark out.

Federal control gages are also available through machine tool manufacturers for control of either plain or I.D. grinders and are supplied as part of the grinder package. When discussing machine tool requirements, be sure to specify FEDERAL gaging. Federal maintains close engineering alliance with leading machine tool manufacturers. They, too, will be glad to discuss automatic control gaging with you.

For more information, contact the nearest FEDERAL representative or write . . .

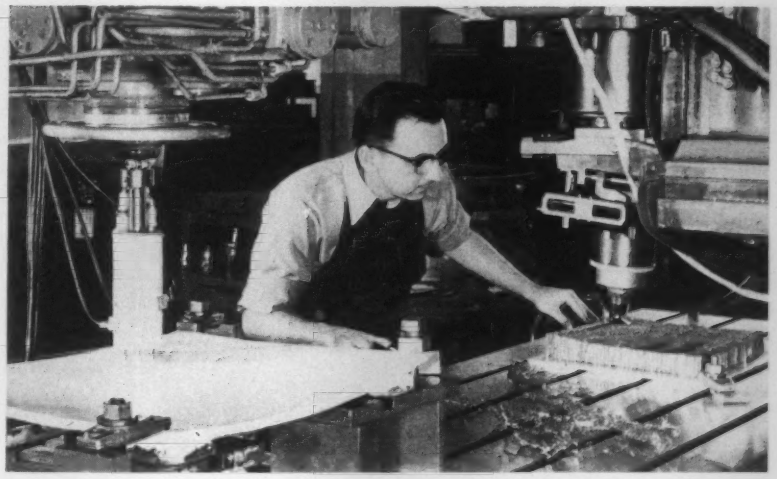
FEDERAL PRODUCTS CORPORATION
9395 Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

for recommendations in modern gages . . .

Dial Indicating, Air, Electric, or Electronic – for Inspecting, Measuring, Sorting, or Automation Gaging

Circle 667 on Page 17



MACHINE cutter head with a capability of performing compound contour movements has been developed by Martin Co. to machine structural shapes from honeycomb core material. Modified stylus with 5 pick-up points, left, and a new machine head, right, permits a standard 3-axis cutting machine to perform as a 5-axis machine. The stylus rides the surface of a wooden or plaster contoured model and transmits rise, fall, and tilt motions to the cutter head. The tilting is limited to a range defined by a 10 degree inclination from the vertical in either of two perpendicular planes. The new method of machining is designed to accurately produce both male and female compound contour shapes out of honeycomb structures without requiring a filler substance to rigidize the core.

An area of much misinformation is the question of tax advantages offered by leasing. Leasing is not a method of tax avoidance—its primary value lies in the way it frees working capital for other uses. In certain specific situations leasing may also offer companies advantages of tax-timing which are not to be ignored. Leasing charges are legitimately deductible as business expenses, and, as such, reduce taxable income now.

Leasing may also offer a tax advantage that can be of particular importance to companies which find that their equipment tends to become obsolete much more quickly than government depreciation tables permit. For example, a company using equipment which should be replaced in 7 years may find that the equipment must be depreciated over 15 years. By leasing this equipment for a 7-year period, this company would be able to deduct the full cost of the equipment from taxable income in 7 years. If the company had purchased the equipment, it would have used only 7 years worth of depreciation and would have to forego further depreciation benefits, if it wished to replace the equipment at the end of 7 years. In certain sale-leaseback situations, tax advantages may accrue, since the sale of an asset normally involves taxation at a capital gains rate—if a profit is made—rather than at a corporate rate.

The final decision of lease or buy must be determined by the individual company. There is no method of financing that fits every situation equally. Factors to be judged include the availability of working capital, the rate of profit the company earns on working capital, the effect of leasing on the company's cash flow as compared with other financing methods, the company's competitive situation, and whether there are any tax advantages in the company's special situation.

Closed Loop Computer Control Runs Polymerization Process

COMPUTER-CONTROLLED polymerization unit has been put on stream at the Port Arthur, Texas, refinery of The Texas Co. According to **James W. Foley**, president of the company, this is the first time that an industrial process has been completely controlled by a computer on a full-scale plant operation. Heretofore, The Texas Co. president stated, computers have analyzed data and performed calculations for control, but they have never fed back their judgments into the plant and actually controlled its operations.

The polymerization unit takes a mixture of gases and hooks their molecules together under high pressure and temperature control in the presence of a catalyst to turn them into high-test gasoline blending stock. The unit handles around 15 million cubic feet of gas per day and has an output of blending fuel

STROMBERG-CARLSON
TELEPHONE HANDSETS

. . . for your voice communication needs.

These "push-to-talk" handsets are of the most modern design available.

If your applications are in • **mobile radio** • **intercom systems** • **carrier and microwave** • **aircraft and railroad** — specify Stromberg-Carlson handsets.

No. 26: short, lightweight, sturdy. Comes with capsule-type receiver and transmitter.

No. 28: "push-to-talk" handset. Rocker-bar switch; various spring combinations.

Both models available with standard or high-gain transmitters and receivers. Superior to any other handset on the market.

Modern handset cradle for mobile or panel use

Holds handset firmly; is strong and resilient; fits any Stromberg-Carlson handset. Switch combinations with two or four Form C contacts. Space for your company name is provided. Send for Handset Bulletin T-5005 and Cradle Bulletin T-5013. Write:

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
Telecommunication Industrial Sales
111 Carlson Rd. • Rochester 3, N. Y.

Circle 668 on Page 17

PAR

the TRS Process that employs standard and multi-head machines to make riveting practically a new fastening method!

PAR . . . Production Automated Riveting

Perfected for over 3 years . . . proved successful in some of industry's most efficient plants . . . the TRS PAR Process opens the way to new economies for 7 out of 10 assemblers of metal products.

Through TRS Production Automated Riveting, costly manual handling of parts on the machine and between machines may be much reduced. Operations may be performed in multiple, simultaneously. Rate of fastening may be speeded up to an unheard-of point. Machine down-time and rejects cut to a negligible amount.

Automation of Assembly Operations becomes a reality through efficiently integrated and automatic . . .

1. FEEDING of tubular rivets or related products.
2. TRANSFER of parts to — or between — riveter stations.
3. SEQUENCING from 3 to 15 rivet setters to operate simultaneously or in any desired order.
4. CONTROL of setting force as required by parts thickness or material characteristics.
5. SENSING of improper conditions and stopping equipment to avoid injury to parts, equipment, or operator.
6. EJECTION of parts as required.

WHY only TRS Can Offer the PAR Process . . .

Obviously, there are two vital elements in the PAR process. Essential is the special knowledge and experience acquired by TRS engineers through the design, tooling and application of many Multi-Head Riveters for complicated production requirements. TRS originated Multi-Head Riveters over three years ago and is the only experienced source of these machines. Equally important, and partly resulting from this unique TRS experience, is superior knowledge of how to design an efficient system of riveters, feeders, transfers and controls . . . whether with standard riveting machines or Multi-Head Riveters

TRS

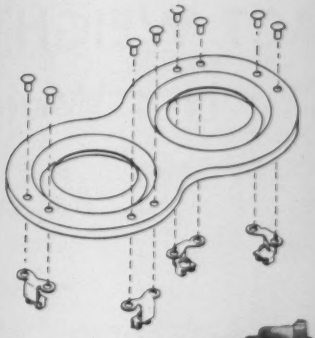
TUBULAR RIVET & STUD COMPANY

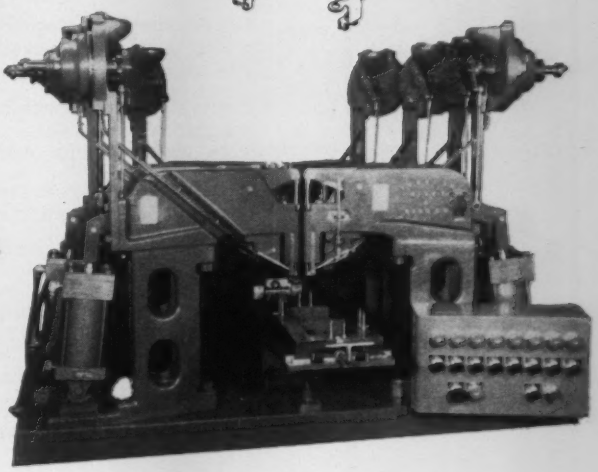
Quincy 70, Mass.

TRS SALES OFFICES: Atlanta • Buffalo • Charlotte • Chicago • Cleveland
Dallas • Detroit • Hartford • Indianapolis • Los Angeles • New York
Philadelphia • Pittsfield • Quincy • St. Louis • Seattle.
WAREHOUSE IN CHICAGO See "Yellow Pages" for phone numbers

ELECTRIC AUTO-LITE

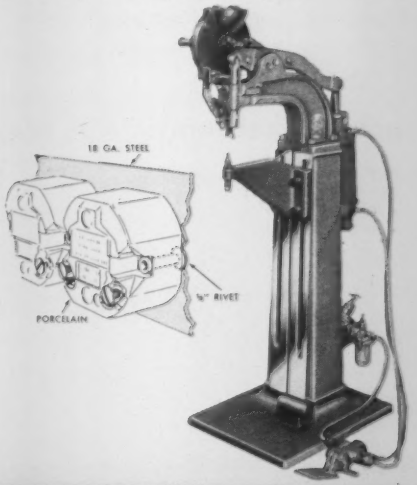
attaches 4 brackets at a time with push-button speed





Dual headlight frames required the attachment of four angle brackets with eight rivets. Electric Auto-Lite invited TRS engineers to help develop a way to do it at high speed, with a minimum of manual handling. The solution is shown here . . . an ingeniously engineered TRS multi-head riveting set-up of eight independent air-powered machines working on very close centers, and a sliding loading fixture containing eight anvils. The operator need only load the frame and brackets, slide the loaded fixture into riveting position and press a button. All eight rivets are set simultaneously. A hold-down attachment on the loading fixture keeps the workpiece in position until released by the operator. A push-button panel permits independent cycling of any one or any combination of riveters if desired. An important feature of the set-up is in the relative simplicity of rearranging the machines as needed to accommodate a future change in parts design.

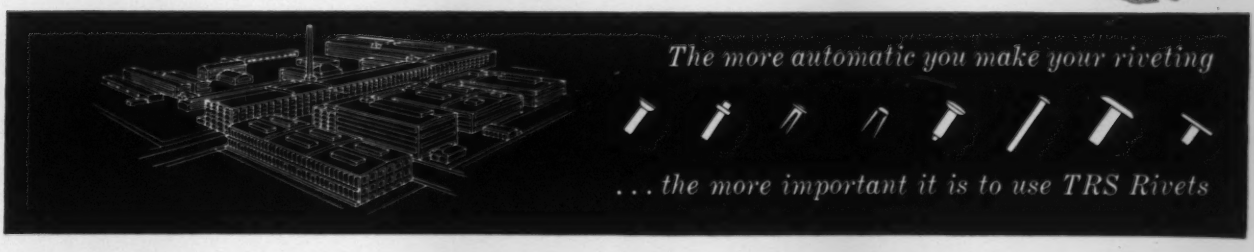
. . . *and* **LIBERTY ELECTRIC** *rivets porcelain switches with a standard machine, 1/6 of the labor, and no breakage*



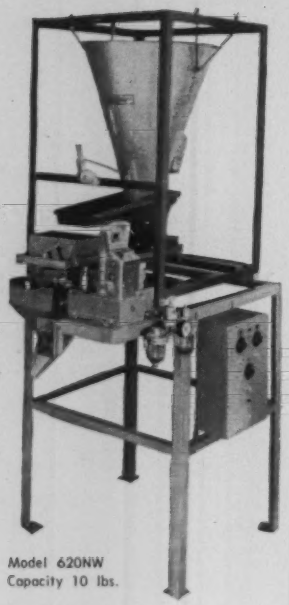
Nut-and-bolt assembly of porcelain-base switches on an electric stove was slow, used relatively expensive fasteners. Automatic riveting would be far faster and cheaper — but how to avoid breaking the switches under the force of the setting? The TRS man had the answer: an air-powered long-stroke modification of a standard TRS riveter, adjustable for "cushioned" setting of the right size of cad-plated semi-tubular rivets. Results: Savings of 5/6 of the labor, savings in fastener cost per unit, higher uniformity of product, and no breakage.

ASK to see more Case Studies . . .

. . . if your product can be riveted, and especially if several rivets are involved, phone or write that you want to see the detailed exhibit of the way many plants, large and small, use the TRS PAR Process.



EXACT WEIGHT® Automatic Net Weighing Machine



Model 620NW
Capacity 10 lbs.

FOR PACKAGING, BAGGING, BATCHING, COMPOUNDING

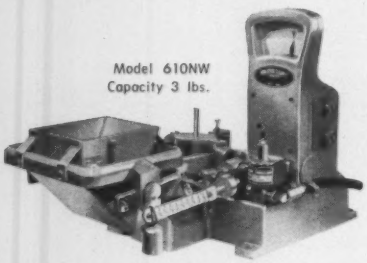
Exact Weight offers:

- Precision industrial-type scale.
- Over-under indicator visual check eliminating need for separate checkweighing operation.
- Calibrated adjustments with counterweights of known value; graduated beam, poise and scale indicator.
- Design backed by 45 years of experience in specialized weighing equipment.
- Readily accessible service and maintenance facilities.
- Performance guaranteed in writing.

Weighs and feeds any dry, free-flowing materials . . . fast and accurate operation . . . helps cut production costs. Write for Bulletin 3318 for details and specifications.

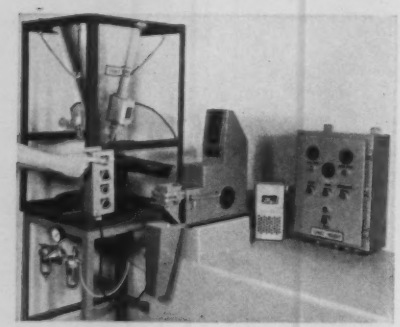
Automatic Net Weigher

Net Weigher can be supplied without the feeder machine, support frame and discharge chute. The unit may be adaptable to your specific operation. Write for Bulletin 3311.



Model 610NW
Capacity 3 lbs.

Precision Automatic Net Weighing Machine



Model 4601NW, left, for weighing dry products with accuracies of 1/10 gram on quantities below 10 grams and one percent accuracy on quantities of 10 grams and above. Combines a high - accuracy Shadograph Scale, air-operated dump mechanism, hoppers, vibratory feeders and photoelectric controls. Models with capacities from 50 grams to 500 grams. Write for Bulletin 3363.

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.

Exact Weight SCALES

Sales and Service Coast to Coast

Find us in your local 'Yellow Pages'

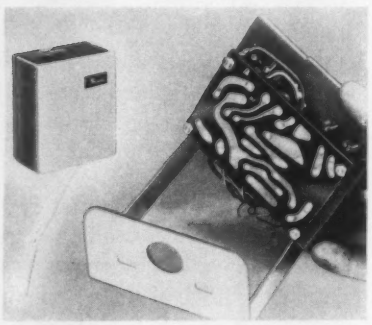
BETTER QUALITY CONTROL . . . BETTER COST CONTROL

of over 1800 barrels per day.

A RW-300 digital computer manufactured by Thompson-Ramo-Wooldridge Products Co. is used to control the refining unit costing nearly $4 million. The computer analyzes incoming gases; measures pressures, rates of flows, and temperatures; and relates these variables to both input and output. It then evaluates all the variables, makes a judgment in the light of a predetermined mathematical model for maximum efficiency at the moment, and resets the plant's control every 5 minutes to conform to this judgment. Savings from more efficient use of catalyst materials alone are expected to be around $75,000 per year. The company hopes to realize an increase of efficiency of 6 to 10 per cent in the polymerization unit.

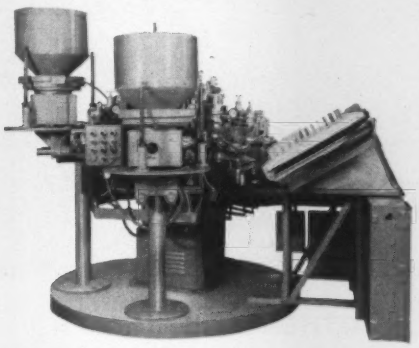
College Professors Offered Process Control Course

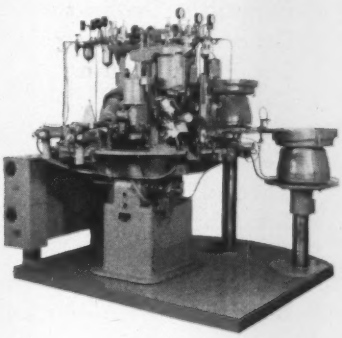
APPLICATION of the principles of instrumentation and automatic control to petroleum and chemical processes of all kinds has become a necessity in order to achieve the productivity required in modern manufacturing. The development of systems concepts applied to processes and to the control of processes under dynamic conditions has resulted in a new field of engineering. College

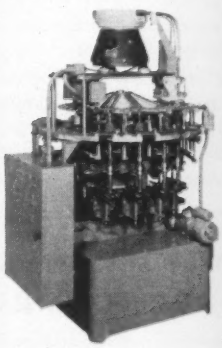


THERMISTOR sensing probe feeds into a transistor amplifier in a new temperature controller announced by Fenwal Inc. Designed for single point control, the unit covers a temperature range of 0 to 600 F. The thermistor sensing element may be mounted several hundred feet from the controller itself and connected by uncompensated standard electric wiring. The controller contains a transistor amplifier, a dial for temperature control point adjustment, and a relay to apply power to heaters, alarms, or other external loads.

Practically Speaking . . .







—who has all the answers on automation equipment?

We don't. BUT—

We had twenty years of specialized experience in designing and building automatic processing and assembling machines *before* the word was ever coined.

In designing and developing good automatic machines, there is no substitute for experience and you can have the benefit of ours without extra cost or obligation.

Whether it's for complete machines or one of our 200 tested and proven Standard Indexing Machine Chassis ready for application to your own designs, you owe it to your company to investigate.

SWANSON-ERIE CORPORATION

SINCE SEC 1919

814 EAST EIGHTH STREET • ERIE, PENNSYLVANIA

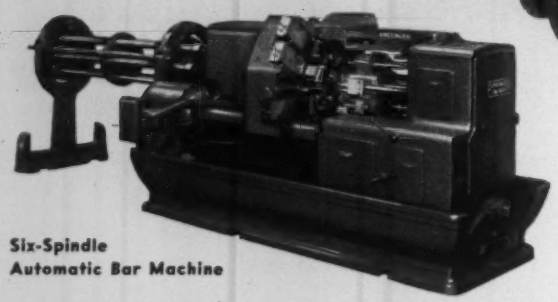
AUTOMATIC ASSEMBLING AND PROCESSING MACHINES

Circle 671 on Page 17

GREENLEE MILLING ATTACHMENT

PRODUCTION MACHINERY

GREENLEE



Six-Spindle
Automatic Bar Machine

Mounts on Main Tool Slide

The Greenlee milling attachment eliminates second operation milling on many jobs. Two millers, normally mounted in 3rd and 4th positions, can profitably mill squares or double slot end of work piece at bar automatic speeds. The cutter head rotates at the same RPM as the work piece. Cutter speed is independent of spindle speeds. The Greenlee milling attachment is only one of many versatile standard and special attachments that expand your job range . . . increase your profits. Find out how Greenlee attachments can help you. Get the details from your Greenlee Distributor.

Write for your copy of Catalog A-405 — first step on the way to more profitable production with Greenlee Automatic Bar Machines.

OTHER GREENLEE ATTACHMENTS AVAILABLE

- Eccentric Boring
- Eccentric Drilling
- Eccentric Forming
- Eccentric Turning
- Crimping
- Gear-Fed Reaming
- Relieved Type Facing
- Thread Rolling
- Broaching
- Trepanning
- Hollow Milling
- Burring

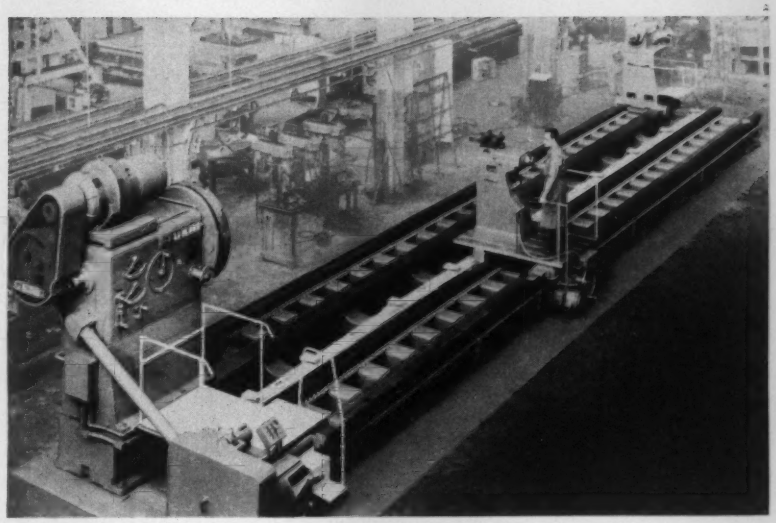
GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines
- Die Casting Machines

GREENLEE
BROS. & CO.

1754 MASON AVE.
ROCKFORD, ILL.

Circle 672 on Page 17



DOUBLE-BED LATHE built by R. K. LeBlond Machine Tool Co. for Aerojet-General Inc. created quite a shipping problem since only three railroad cars in the country could handle it. The machine tool weighs in excess of 75 tons and can handle a workpiece that is 45 feet long and 105 inches in diameter. The lathe has a range of speeds from 1 to 110 rpm and feeds as low as 0.01 inch per revolution. The machine operator rides on the lathe carriage on one set of the ways with access to most of the machine controls, including remote controls for the headstock. In contrast to its large size, the lathe is equipped with only a 50 hp variable speed motor.

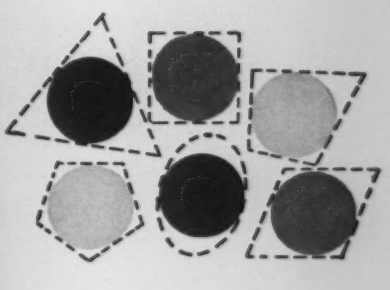
instruction in this field, heretofore, has been mainly based upon the information and theory of process statics. However, industrial processes rarely operate in a condition of equilibrium for they are continuously disturbed and require manipulation and correction by either manual or automatic action.

The National Science Foundation has announced a grant of $20,000 to Case Institute of Technology to support an experimental summer conference which will expose a group of Chemical Engineering college professors to the theory and techniques of process control dynamics. The need for the forthcoming summer conference was conceived by the Foundation for Instrumentation Education and Research (FIER) and the Process Control Subcommittee of the American Institute of Chemical Engineers.

The three week conference will be held from July 6 to July 24, 1959, and will be under the direction of **Donald P. Eckman** and **Irving Lefkowitz,** professors at Case Institute. Applicants to the conference can come from any A.I.Ch.E. accredited college or university now offering an undergraduate program of instruction in chemical engineering. The thirty most-qualified candidates will receive free tuition, allowance for travel, and stipends of up to $15 per day. The conference will consist of an intensive short course composed of lectures, laboratory experiments, and discussion periods devoted to the development of control theory, and mathematical background for dynamic analysis. Interested applicants should contact FIER, 335 E. 45th St., New York, N. Y., for application forms.

SPOTLIGHTING PEOPLE

Harry L. Huntsinger appointed executive vice president of Potter & Brumfield Inc. . . . **John R. Keates** named vice president in charge of sales at National Automatic Tool Co. Inc. . . . **Dr. David R. Helman** appointed consulting computer engineer-operations analysis in the Computer Dept., General Electric Co. . . . **Wallace S. Whittaker** elected chairman of the executive committee, Pratt & Whitney Co., and chairman of the board at Potter & Johnston Co. . . . **Harry Tiffany** appointed head of special products for Sahlin Engineering Co. Inc. . . . **Thomas Bannon** named director of production engineering, and **John Cameron** appointed assistant chief engineer in charge of technical services at Clearing, Div. of U. S. Industries Inc. . . . **Harold F. Schulte** appointed chief engineer of Wheel-



Air 150 psi
Hydraulic up to 1500 psi
Meet JIC Standards
Series 101A

O-M Cylinders

Fit Where Others Won't

THESE original space-saving O-M cylinders do more than fit into unusually close quarters too small to accommodate tie-rod cylinders of the same size bore. They save weight, improve appearance and assure smooth, dependable performance within a wide range of operating pressures. In addition, they are readily modified to serve in special applications, requiring semi-standard cylinders. And, the O-M Internal Locking Key, that makes it possible to orient the ports to any position, simplifies disassembly, inspection and service, eliminating alignment problems upon assembly. Completely interchangeable mounts and parts.

Available in 1½" to 8" bores with standard or heavy-duty piston rods.

Mail coupon today for 28-page Bulletin 101A replete with engineering drawings of cylinders, mounts, mounting brackets, capacity chart, and other performance data.

ORTMAN-MILLER MACHINE CO.

25 143rd Street,
Hammond, Indiana

☐ **Have representative call**
☐ **Send Bulletin 101A**

Name_____ Position_____

Company_____

Address_____

City_____ Zone____ State_____

Circle 673 on Page 17

THE MARK OF QUALITY

BARBER COLMAN

Wheelco Instruments

Built-in leadership—

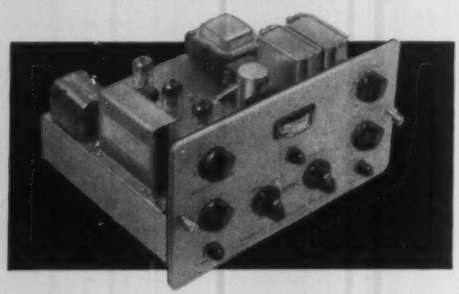
No need to wait . . . get with "field-proved"

There's no need to wait for new designs or hold up a recorder purchase until you're sure that the features you've heard about really work. Wheelco potentiometer recorder controllers — whether circular or strip chart — have the features you want *right now.*

Why settle for less when Wheelco recorder controllers offer you all these as standard — *at no extra cost:*

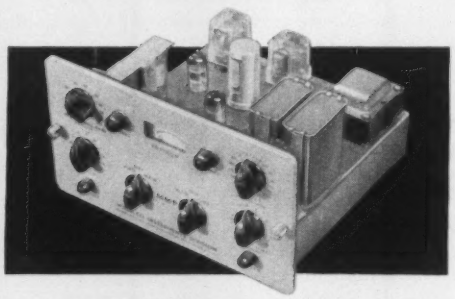
1. **CONSTANT VOLTAGE SOURCE** — proved in more than three years of field operation and available at no extra cost. Silicon diodes eliminate batteries and standard cells.
2. **QUICK RANGE CHANGE** — no soldering, just loosen 5 screws to replace range change brackets.
3. **PLUG-IN COMPONENTS** — downtime is sharply reduced and repairs can be made without tying up equipment with Wheelco pioneered plug-in components.
4. **ACCESSIBILITY** — inspection, adjustment and cleaning of complete instruments are simplified. Swing-out design

MM SERIES CONTROLLERS FOR PROPORTIONAL RESET AND RATE ACTION



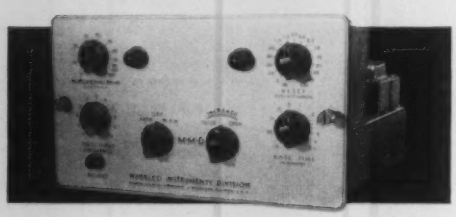
MMC CURRENT OUTPUT TYPE

Flexible in adaptation to final control elements including saturable reactors, electropneumatic transducers, electrohydraulic transducers; as well as other compatible electric systems.



MMP POSITION TYPE

Can operate a valve, valve positioner or other positioning device. Reset action is adjustable from 0.6 to 100 repeats per minute, rate action from 0 to 5.5 minutes.



MMD DURATION TYPE

Regulates input by adjusting on-time of a contactor on either electrical or fuel-fired installations. Ideal when upsets are fast and recovery slow or when large and frequent.

MP PROPORTIONAL POSITIONER

Mounts in the instrument, provides proportional control by modulating the position of final control element as a linear function of the value of the measured variable.

the recorders advanced design

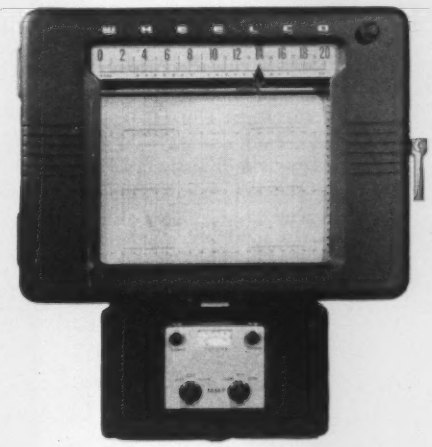
of principal elements on all Wheelco recorders permits fast adjustment, chart change, etc.

5. SIMPLE CHANGE OF BALANCING SPEEDS — changing a 15-second recorder to a 2-second recorder requires removing 3 steps of gearing. The two-phase balancing motor remains the same for all speeds.

ALSO FIELD-PROVED CONTROL FORMS WITH EXCLUSIVE MAGNETIC MODULATORS — Proportional rate and reset action on round and strip chart instruments offered by MM series controllers of the current output, position, or duration type.

SERIES 2000
ROUND CHART RECORDERS AND RECORDER CONTROLLERS

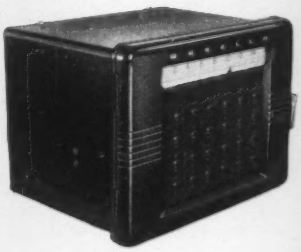
are also self-contained, null-balancing potentiometer instruments, the newest in the Wheelco line. Pen speeds are 1, 4, or 20 seconds at 60 cycles a-c. The 12-in. diameter chart has a calibrated width of 4⅝ in. Instrument accuracy is ± ¼ of 1% for all scale spans of pyrometric range. External control point setters are optional. All standard chart speeds are available; also a complete range of control forms including three-function type.



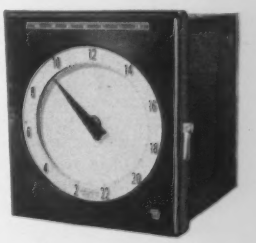
SERIES 8000
RECORDERS AND RECORDER CONTROLLERS

Self-contained, null-balancing electronic instruments designed for long life and trouble-free service. Wide range of models provides for measurement, indication, control, and permanent recording of temperatures and (with transducers) other variables such as speed, strain, ph, and any other quantities that can be resolved into electrical signals. Multipoint recorders handle up to 24 points at speeds from 3 to 24 inches per hour. Multibank (scanner) setups permit recording 144 or more points. Shown at left is recorder controller with automatic reset in tamperproof cover.

Rounding out the Wheelco line



Wheelco 9000 Series multiswitch indicators enable rapid checking of temperatures at as many as 108 stations. More stations require only an additional switch housing cabinet.



Circular scale 3000 Series indicators and Indicating Controllers have large, bold, distant-reading scales and generally parallel construction of 2000 Series recorders described above.

BARBER-COLMAN COMPANY

Dept. Q, 15108 Rock Street, Rockford, Illinois, U.S.A.

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Small Motors
Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Circle 674 on Page 17

RANSBURG *Electro-Spray...*

PROVIDES 50% PAINT SAVING (over the former dip method) in the finishing of KAY-MAR DINETTE FURNITURE

A high quality, long-lasting finish is applied to tubular chair frames as they make a loop around the Ransburg No. 2 Process reciprocating disk in the finishing department at Kay-Mar Industries.

● Kay-Mar Industries, Cassopolis, Michigan, switched from the dip method to Ransburg Electrostatic Spray Painting because they wanted to improve the quality of the finish on their metal furniture line.

Now, with electrostatic spray painting, they get a heavier, more uniform application, which was not possible with former dip. With electrostatic, they are able to use metallic coatings with higher metal content. In their magazine advertising to the mobile home industry, they proudly say: "Finest finish in the industry at no additional cost to you!"

Electrostatic provides other advantages at Kay-Mar. They picked up some additional—and much needed—floor space when dip tanks were removed. Their insurance rates were reduced because of improved "housekeeping" conditions. Frequent color changes are made quickly and simply, and rejects—which used to run 1½%—are reduced to less than a quarter of one per cent.

NO REASON WHY YOU CAN'T DO IT, TOO!

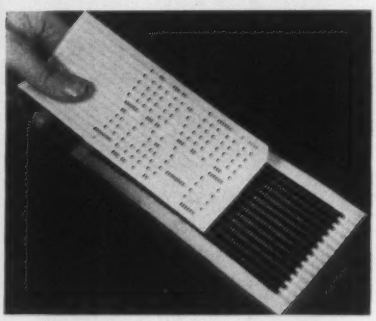
Let us test prove the advantages of automatic electrostatic spray painting on your products in our complete laboratories. No obligation. Call or write for our No. 2 Process brochure, which shows a variety of automatic painting installations on a wide variety of products. Or, if your production doesn't justify automatic painting, let us tell you about the new Ransburg No. 2 Process electrostatic hand gun, now widely used by both large and small manufacturers.

RANSBURG

RANSBURG
Electro-Coating Corp.
Box-23122, Indianapolis 23, Indiana

Circle 675 on Page 17

abrator Corp. . . . **Dr. Walter M. Urbain** named director of engineering research for Swift & Co. and will supervise development work in automated processing methods. **B. T. Hensgen** appointed associate director of engineering research for the same company and will direct work in equipment development . . . **John W. Lyon** appointed vice president in charge of manufacturing for General Binding Corp. . . . **Louis Lovisek** named manufacturing manager in charge of manufacturing, planning, and engineering for Parker-Kalon Div., General American Transportation Corp. . . . **Dr. Donald P. Eckman**, professor of mechanical engineering at Case Institute of Technology, named recipient of the American Society of Mechanical Engineers Annual Award for outstanding work in the field of instrumentation . . . **Arch T. Colwell** appointed vice president of engineering, research, and development at the corporate staff level of Thompson Ramo Wooldridge Inc. . . . **Frank Grady** named head of the manufacturing department at Fairchild Semiconductor Corp. . . . **Rocco R. Reale** appointed manufacturing manager of the Industrial Electronics Div., Allen B. Du Mont Laboratories Inc. . . . **Newton E. Armstrong** named manager of the Systems Development Div., Southwestern Industrial Electronics Co.



PHOTORECTIFIER plates developed by Lincoln Laboratory, Massachusetts Institute of Technology, can be used in conjunction with punched card systems to replace mechanical methods of film reading, card reading, and character recognition. The plate shown is equivalent to a soldered network of 960 individual photo diodes and requires only 1/20 the space of the diode network. Each photorectifier in the plate acts as a diode when illuminated and becomes an open circuit when masked. By varying the hole patterns in different masks, circuit networks can be quickly and easily changed. The photorectifier plates will be marketed by the Rex Corp.

Circle 676 on Page 17→

GAYLORD SIGHTS IN ON YOUR PACKAGING OBJECTIVES

Gaylord first surveys your packaging and handling operations. Then research and engineering team up to evaluate findings, coordinate results with newest Gaylord packaging developments . . . and recommend corrugated containers of highest efficiency, at lowest cost.

Regular corrugated containers in big volume . . . or engineered packaging . . . call your G-Man. He'll help you sight the shortest distance to dependable, economical packaging.

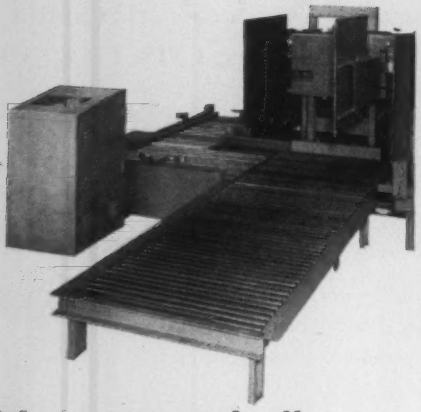
GAYLORD
CONTAINER CORPORATION

Gaylord Boxes

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

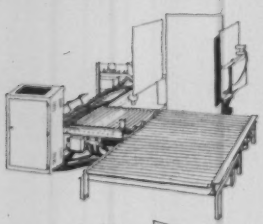
DIVISION OF **Crown Zellerbach Corporation**

Ask Standard how to:



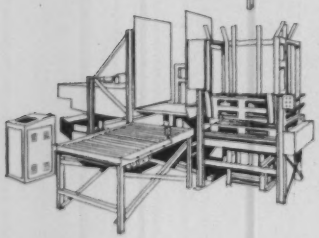
- Palletize or unitize *automatically*
- Unstack palletized or unit-loads *automatically*

Standard Conveyor Company offers a wide range of precision engineered machines for fast, automatic assembly, as well as unstacking of palletized or unitized loads — applicable to a wide variety of cased merchandise — operate at convenient low working level — faster than manual methods — save man-hours.



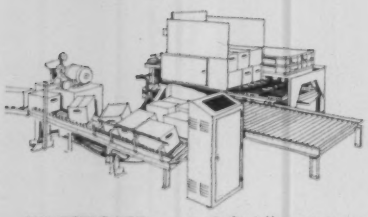
CLAMP-TYPE UNITIZER

Assembles unit-loads in desired size and shape automatically in a steady, uninterrupted flow directly from conveyor. Forms unit-loads by clamping and lifting successive layers of cases. 1800 lbs. maximum unit-load capacity; can be used with or without pallets.



LO-LOAD TYPE UNITIZER

Automatically receives individual cases from conveyor lines and arranges them into unitized load. Operates at low working level. Builds loads in successive layers of cases through finger supports which retract as layers are completed. 2500 lbs. maximum unit-load capacity; handles items packaged or bottled in glass containers.



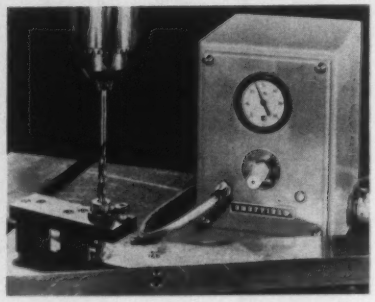
UNITIZER UNSTACKER

Unstacks pallet unit-loads automatically, up to 45 cases per minute. Lifts load from pallet (which is automatically moved into pallet stacker). Successive layers of cartons are released and single cases fed onto outgoing conveyor line.

INVESTIGATE — send for literature and complete information on machines suitable for your merchandise. Write Dept. EE-3, Standard Conveyor Company, North St. Paul 9, Minnesota.

Standard
GRAVITY & POWER
CONVEYORS
Sales & Service in Principal Cities

See Our Exhibit 1959 Material Handling Exposition June 9-12 Cleveland Booths 1941-1943



PNEUMATIC drill detector unit has been developed by the Sheffield Corp. to sense broken drills or the absence of drills in automatic drilling operations. An air nozzle, mounted between the drill bushing plate and the workpiece, directs a stream of air against the drill as it is fed into and retracted from a part. A broken drill causes a pressure drop in the pneumatic circuit which, in turn, initiates an electrical impulse to operate signal lights and relays to stop the machine. The unit can also be used to detect broken reamers, taps, and other types of tools.

. . . **Joseph Statsinger** joined Servo Corp. of America as director of engineering . . . **Charles M. Coffin** appointed vice president-manufacturing for B. F. Goodrich Industrial Products Co. . . . **Paul V. Brown** appointed manager-manufacturing of the La Verne, Calif. plant of Taylor Fibre Co.

SPOTLIGHTING PLANTS

Snyder Corp. has purchased the **Hope Machine Co.**, builder of filling machines for packaging processes in the food, dairy products, chemical, pharmaceutical, paint, cosmetic, and building products industries. The Hope machines will be engineered and built by the Arthur Colton Co. Div. of Snyder Corp. . . . **Potter & Johnston Co.** has moved its engineering and manufacturing operations from Pawtucket, R. I., to the plant of its parent company, **Pratt & Whitney Co. Inc.**, in West Hartford, Conn. . . . **C. F. Simmers Inc.** is the name of a newly formed company which will specialize in heavy crane, rolling mill, and allied equipment design, and industrial and steel plant layout. . . . **Hoffman Electronics Corp.** has started construction of a $1.5 million Los Angeles plant for the production of semiconductor equipment. . . . **Meriam Instrument Co.** has announced the acquisition of **I-L-S Instrument Corp.**, design-

Circle 677 on Page 17

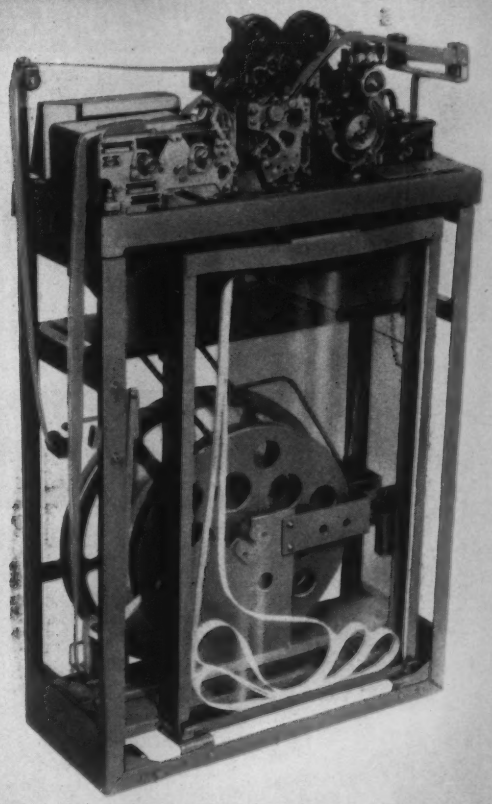
For a wide range of applications in—

Communications

Data Processing

Automation

Model 28 RT Sets may be mounted in pairs in this newly designed Teletype Universal Cabinet, ideal for office or communications center installation.



New Teletype Model 28 RT Set

The Teletype Model 28 Reperforator Transmitter-Distributor Set features *three* facilities in one unit. It combines: (1) a typing or non-typing TAPE PUNCH . . . with (2) a TAPE READER . . . plus (3) intermediate TAPE STORAGE facilities.

This new equipment will accept 30 or 60 ma signals at line speed, convert them into perforations in paper tape, and retransmit the data at the same or another speed.

Speeds from 60 to 200 WPM are available for 5-level code. A manual gearshift permits selection of 60, 75 or 100 WPM, on units with either typing or non-typing tape punches. Units with non-typing tape punches operate at 200 WPM with a fixed gear arrangement.

The Model 28 RT is adaptable to a wide range of applications. For example:

Automatic Switching Systems. For high-speed, cross-office transfer of data.

Relaying. Between carriers or circuits.

Data Processing. Between terminal communications facilities and business machines.

If you would like more information about this new and versatile Teletype unit, please write for descriptive literature to: Teletype Corporation, Dept. 21E, 4100 Fullerton Ave., Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company*, INC.

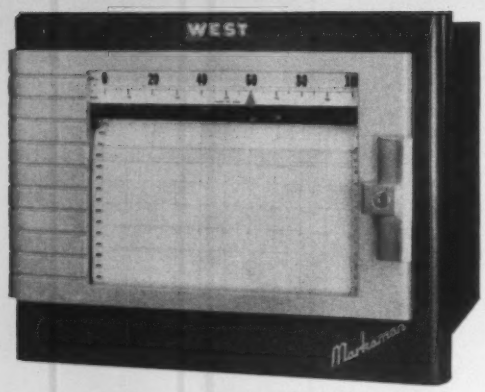
Circle 678 on Page 17

Still hitched to horse-and-buggy recorders?

Boost volume...
assure quality...
control costs
with

Marksman

Tubeless Strip-Chart Potentiometer Recorders



Transistorized, these precise instruments avoid *all* the notorious tube-troubles. Needing no warm-up, adjustment, replacement of tubes or repair of their circuitry, Marksman recorders permit immediate and *continuous* operation...so increase production.

Accurate within 1/5th of 1%, they also include several special features which provide for more user-convenience and consistent quality-control. Users in many lines report Marksman recorders involve less operational cost, as well as reducing waste of other factors.

Let our world-wide service help on your own job. Phone your West consultant (see Yellow pages) or write Chicago office for Bulletin M.

WEST *Instrument*
CORPORATION
SALES OFFICES IN PRINCIPAL CITIES
FACTORY AND GENERAL OFFICES:
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BRITISH SUBSIDIARY
WEST INSTRUMENT, LTD.
52 Regent St., Brighton 1, Sussex

the trend is to **WEST**

ers and manufacturers of pulse circuit electronic tachometers, frequency counters, and special electronic instrumentation. I-L-S will operate as a division with no contemplated change in personnel or location. . . . **Southwestern Industrial Electronics Co.** has opened a new 300,000 sq ft research, development, and manufacturing facility in Houston, Tex. . . . **Motch & Merryweather Machinery Co.** has announced that its Manufacturing Div. has entered into a manufacturing agreement with **Heller Bros.** of Nuertingen, Germany, one of Europe's largest machine tool companies. The arrangement will provide for the interchange of engineering data and technical information. . . . **Bell Automation Corp.**, manufacturer of electronic bulk weighing and handling equipment, has moved into new and larger quarters in Rochester, N. Y. . . .

Commercial Contracting Corp. has moved from Detroit to Madison Heights, Mich. and consolidated its executive, sales, and operating offices, together with its equipment yard, in one location.

MEETINGS AND EVENTS

May 11-13—

Instrument Society of America. Second Annual Power Conference to be held at the President Hotel, Kansas City, Mo. Additional information is available from Charles Koegel, Westinghouse Electric Corp., 8900 Westbrook Drive, Overland Park, Kans.

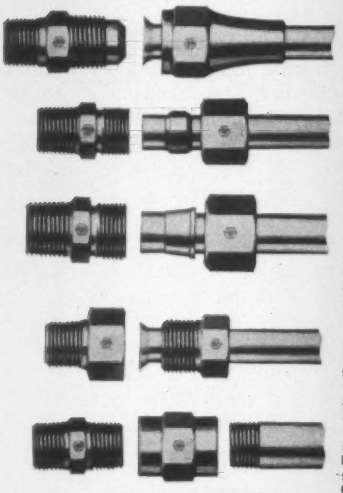
May 11-13—

Second Annual Joint Conference on Automatic Techniques. Sponsored jointly by the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Institute of Radio Engineers, meeting will be held at the Pick Congress Hotel, Chicago. For further information, contact F. D. Snyder, Westinghouse Electric Corp., 40 Wall St., New York 5, N. Y.

May 12-14—

American Society of Mechanical Engineers. Production Engineering Div. Conference to be held at the Statler-Hilton Hotel, Detroit. Additional information is available

brass tube fittings



S.A.E. 45° FLARE
USE with copper, brass, aluminum, steel and plastic tubing. U.L. listed; A.G.A. approved. Meets SAE Hydraulic standards and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 3000 p.s.i. Sizes: ⅛" to ¾".

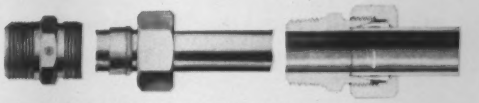
COMPRESSION
USE with copper, brass, aluminum and plastic tubing. U.L. listed; A.G.A. approved. Meets SAE Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 2000 p.s.i. depending on O.D. of tube. Sizes: ⅛" to ¾".

SELF-ALIGN®
USE with copper, brass, aluminum and plastic tubing. No flaring, soldering, welding, or special tube preparation needed. PRESSURE RATING: up to 2000 p.s.i. Sizes: ⅛" to ¾".

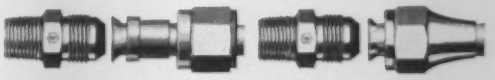
INVERTED FLARE
USE with copper, brass, aluminum, steel and plastic tubing. Meets SAE Hydraulic Tube Fittings and A.S.A. and A.S.M.E. codes. PRESSURE RATING: up to 3000 p.s.i. Sizes: ⅛" to ¾".

PIPE FITTINGS
USE with brass or steel pipe. Meets specifications of SAE TPHL Fittings Committee. PRESSURE RATING: up to 5000 p.s.i. Sizes ⅛" to ¾".

forged steel fittings



ERMETO HYDRAULIC TUBE FITTINGS
Most dependable high pressure fitting in the world . . . easiest installation. FOR FLARELESS TUBE SYSTEMS. No flaring, threading, welding or soldering. Available with carbon steel; stainless steel; cadmium plated or Weathercote finish. Standard Sizes: ⅛" through 2". Pressure Ratings: up to 10,000 p.s.i.

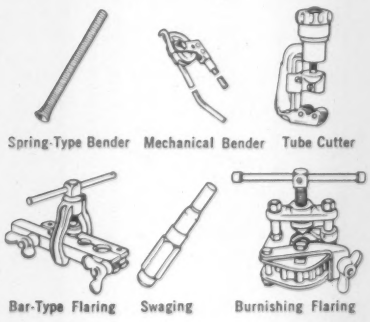


FLARE-TWIN HYDRAULIC TUBE FITTINGS
SAE 37° FLARE (J.I.C.) STEEL FOR FLARE TUBE SYSTEMS. No threading, welding or soldering. Two-pc. and three-pc. carbon and stainless steel with cadmium plated or Weathercote finish. Standard sizes: ⅛" through 2". Pressure Ratings: up to 10,000 p.s.i.

the WEATHERHEAD symbol is your assurance of SERVICE, QUALITY and DEPENDABILITY in all industrial hose and tube fitting needs

tube working tools

Designed to make fast, easy work of every tubing job. We offer a complete line of low cost, quality made tools for cutting, bending and flaring tubing up to ¾" in O.D.



Spring-Type Bender · Mechanical Bender · Tube Cutter

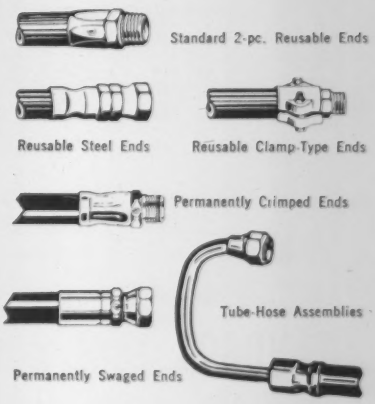
Bar-Type Flaring · Swaging · Burnishing Flaring

hose

Available in over 20 different types for any industrial application up to 10,000 p.s.i. pressures and sizes from ⅛" to 2" I.D. Five standard hoses meet most requirements.

H-9—Low Pressure
H-17—Medium Pressure
H-25—High Pressure
H-69—Medium High Pressure
H-108—Medium High Pressure

hose assemblies



Standard 2-pc. Reusable Ends
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Permanently Crimped Ends
Tube-Hose Assemblies
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THE WEATHERHEAD CO.

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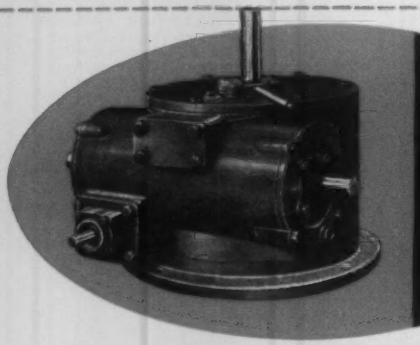
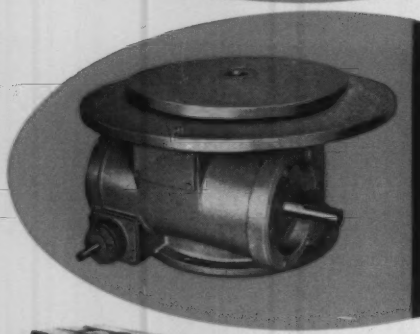
Circle 680 on Page 17

You can
PRODUCE & ASSEMBLE
Automatically
when your machine is designed around a Standard Tool
INDEXING UNIT

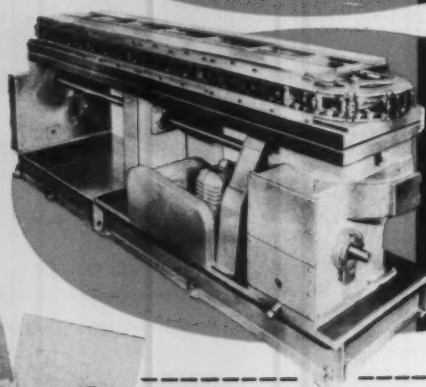
The Heart of Automatic Machines



MODEL ST-A9A
Compact light to medium duty cam indexing unit. 8 to 20 index positions, 90° to 270° cams, 13½" to 24" dial plates. Accuracy ± .001 at 8" radius.



MODEL ST-A9B
Heavy duty cam indexing unit. 8 to 24 index positions, 18" to 24" dial plates. Accuracy ± .001 at 10½" radius. Production rate 600 to 6000 per hour.



MODEL ST-A18
Conveyor or transfer type, straight line indexing chassis. 27 to 51 work carriers, production rate 1000 to 6000 per hour, station distances 3" to 6". Accuracy ± .003.

Technical Booklets Sent on Request!

Standard Tool engineers will be pleased to help you in selecting the indexing unit to meet your exact requirements.
Also ask for Standard Tool facilities brochure.

STANDARD TOOL & MANUFACTURING CO.
Machines for Shaping America's Future
240 LAUREL AVENUE KEARNY, NEW JERSEY
STANDARD TOOL AUTOMATION
Since 1910

from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

May 14-16—
American Institute of Industrial Engineers. Tenth Annual National Conference and Convention to be held at the Biltmore Hotel, Atlanta. For further information contact J. F. Medford, 8246 Roberts Drive, Dunwoody, Ga.

May 17-19—
Instrument Society of America. Fifth National Symposium on Instrumental Methods of Analysis to be held at the Shamrock Hilton Hotel, Houston, Tex. Additional information is available from H. S. Kindler, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

May 20-22—
Electronic Industries Association. Annual Meeting to be held at the Sheraton Hotel, Chicago. Additional information is available from EIA headquarters, 1721 DeSales St. N.W., Washington 6, D. C.

May 25-27—
American Society for Quality Control. Annual Convention and All Industry Production & Quality Control Exposition to be held at Public Hall, Cleveland. Additional information is available from ASQC headquarters, 161 W. Wisconsin Ave., Milwaukee 3, Wis.

May 25-28—
American Society of Mechanical Engineers. Design Engineering Show

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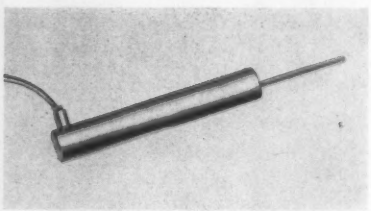
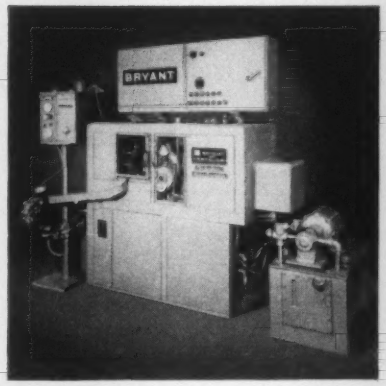


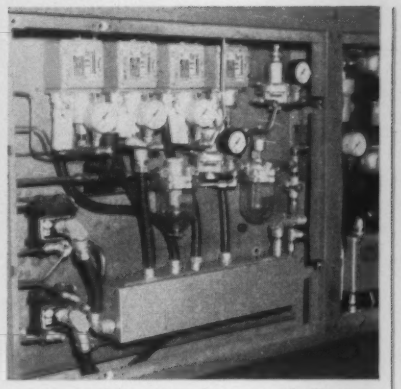
VELOCITY transducer which measures the speed of linear motion has been announced by Vinson Mfg. Co. The unit generates a direct current output signal proportionate to the velocity of linear displacement, without any external excitation. Two coils are potted in a stainless steel housing, and a permanent magnet, moving in the bore of the housing, induces an output voltage in the coils proportional to the linear velocity of the core relative to the housing. In the different units available, sensitivity ranges from 100 mv/inch/sec to 1 volt/inch/sec.

Circle 681 on Page 17

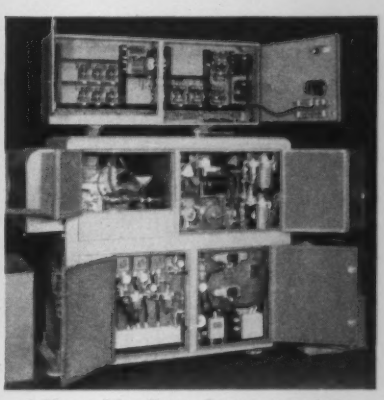
Skinner solenoid valves solve many different cylinder control problems



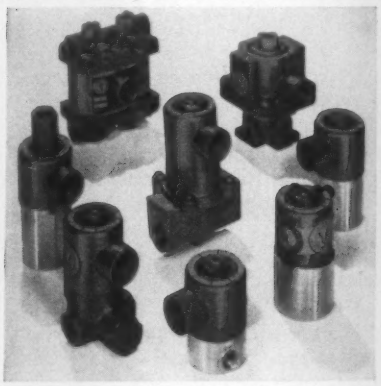
Application. This Bryant "Centalign" automatic internal grinder is an entirely new concept in precison grinding machinery. Work parts are gravity-fed through chutes and loaded to grind position automatically. Centalign design permits higher, more accurate production at lower cost in the grinding of straight or tapered bores or forms such as ball tracks.



Seven Skinner valves used. Four-way, V9 valves control cylinders actuating work ejector, work interceptor and work loading chute. Others control cylinders for activating a diamond holder for wheel sizing; an oscillator for grinding; and a compensating cylinder to skip wheel dressing action. Still another controls the shop-air supply to the machine.



Adjustable flow features of the four-way valves permit split-second adjustment of cylinder action. And all the valves are small, compact and easy to mount at any angle. Built-in spring returns assure positive closing. Such features enable Bryant to manufacture the Centalign in panels that afford easy access to all pneumatic, hydraulic and electric circuits.



A complete line. There's a Skinner solenoid valve for almost any flow application with a wide variety of media: air, oil, water, inert gases, hydraulic fluids, kerosene and gasoline. Orifice sizes range from $\frac{3}{64}$" to 1". Pressure ratings range from 5 psi to 3000 psi. Explosion-proof models are UL approved for Class 1, Group D and Class 2, Groups F and G.

100,000 variations. The Skinner valves used by Bryant are so versatile in design that standard models can be used for applications normally calling for specials. Skinner solenoid valves are engineered to have a life expectancy of millions of trouble-free cycles.

Quality assured. Electrical tests to UL Standards include resistance check of coils in valve; breakdown check of 2x's rated voltage plus 1,000 volts; heat rise check of continuously energized coil for operation not above 85°C (185°F) rise above room temperature. These tests assure that you can use Skinner solenoid valves with confidence.

Skinner solenoid valves are distributed nationally.

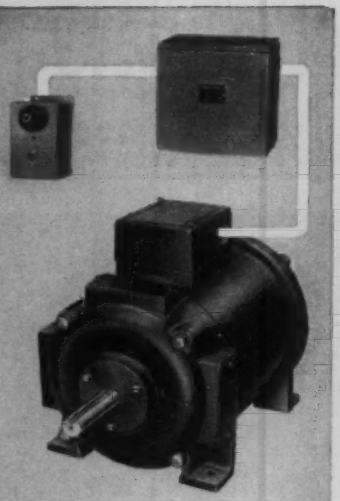
For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 325.

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY

THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT

Circle 685 on Page 17



PRECISION

ELECTRONIC

ADJUSTABLE-SPEED DRIVES

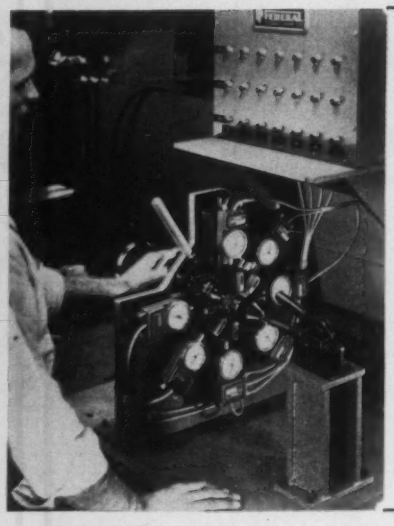
- **SPEED RANGE** Infinitely adjustable from less than 36 rpm to more than 3600 rpm while delivering full rated torque. Continuous duty rating at all speeds.
- **REGULATION** Both line and load regulation is better than ½ of 1% of rated speed.
- **HORSEPOWER** Various models from ¾ hp down to 1/200 hp. Motors of ¼ hp and larger are totally enclosed.
- **REMOTE CONTROL** A 10-turn potentiometer provides precise adjustment at any convenient location.
- **GEARED MOTORS** Motors are available with integral gear reducers.
- **BRAKING-REVERSING** Relay-controlled braking and reversing models available.
- **MAINTENANCE** Fully encapsulated construction results in long service life. Plug-in construction requires only a screwdriver for servicing.
- **OTHER MODELS** Servo-Tek manufactures drives with silicon rectifiers and adjustable autotransformers, as well as other thyratron drives with less exacting specifications. Write for information including details of your proposed use.

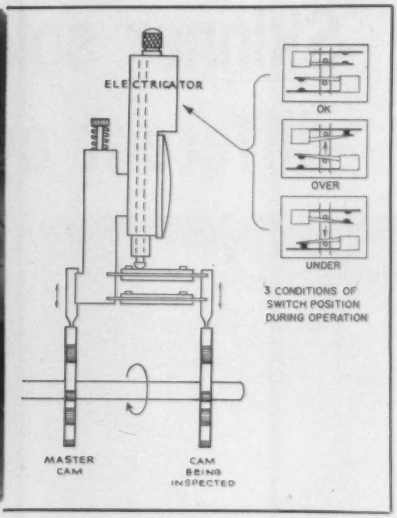
IMMEDIATE DELIVERY

Servo-Tek PRODUCTS CO. INCORPORATED

Main Office
1086 Goffle Road, Hawthorne, N. J.
Western Office
14736 Arminta Street, Van Nuys, Cal.

Circle 683 on Page 17





GROUPS of seven different cams, arranged in stacks, are checked for contour, proper stacking, and broken or chipped edges on a semiautomatic electric gage manufactured by Federal Products Corp. A master cam stack is fixed on a locating shaft, and the stack to be checked is positioned on the same shaft. Coupled gaging contacts ride on the contours of each master cam and its associated cam in the stack to be checked. Any difference between the contacts as the cams are rotated causes the Electricator spindle to move and actuate switching contacts which control signal lights. By glancing at the bank of lights mounted above the gaging station, an inspector can ascertain the acceptability of an entire stack of cams.

and Conference to be held at Convention Hall, Philadelphia. Further information is available from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

June 1-5—

Fifth World Petroleum Congress Exposition. Exhibits and technical sessions to be held at the Coliseum, New York. Additional information is available from E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

June 9-12—

Material Handling Institute Inc. National exposition of materials handling equipment to be held at Public Auditorium, Cleveland. Concurrent technical sessions will be sponsored by the American Material Handling Society Inc., Society for Advancement of Management, and the Material Handling Div., American Society of Mechanical Engineers. Additional information is available from the Material Handling Institute Inc., Suite 759, 1 Gateway Center, Pittsburgh 22, Pa.

June 14-18—

American Society of Mechanical Engineers. Semiannual Meeting to be held at the Chase-Park Plaza Hotel, St. Louis. For further information, contact ASME headquarters, Meetings Dept., 29 W. 39th St., New York 18, N. Y.

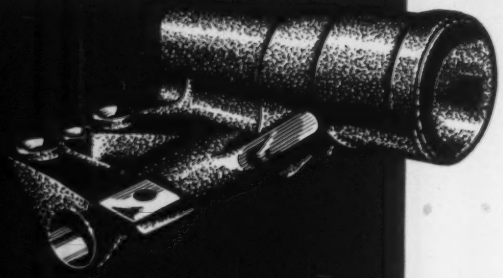
June 14-19—

Society of Automotive Engineers. Summer Meeting to be held at the Chalfonte-Haddon Hall Hotel, Atlantic City. Additional information is available from SAE headquarters, 485 Lexington Ave., New York 17, N. Y.

June 21-26—

American Society for Testing Materials. Annual Meeting to be held at the Chalfonte-Haddon Hall Hotel, Atlantic City. Additional information is available from ASTM headquarters, 1916 Race St., Philadelphia 3, Pa.

Circle 684 on Page 17→

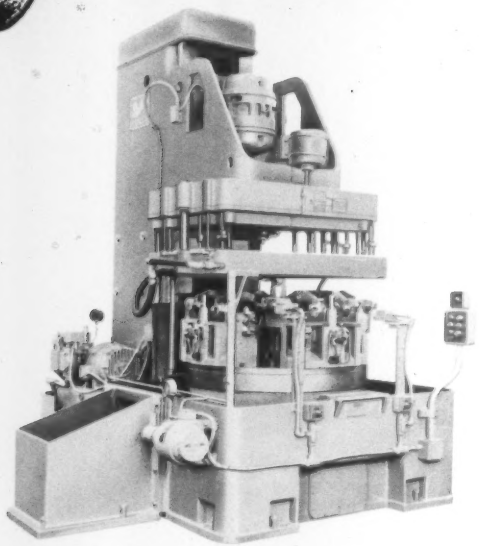


Buhr CONVERTIBILITY now adds years of useful life to machine tools

Convertibility, year by year, has become an increasingly vital feature of all Buhr Economatics. Today there is an even broader use than ever before of standardized 'building block' principles in Buhr machine components and fixtures while close tolerances on such parts insure maximum ease of convertibility.

Today you can count on an even greater part of the original investment in an Economatic to stretch out amortization periods.

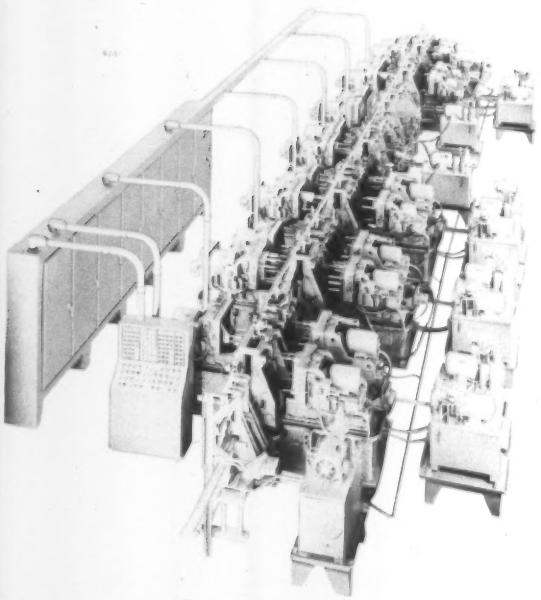
This part was redesign basic machine still pro



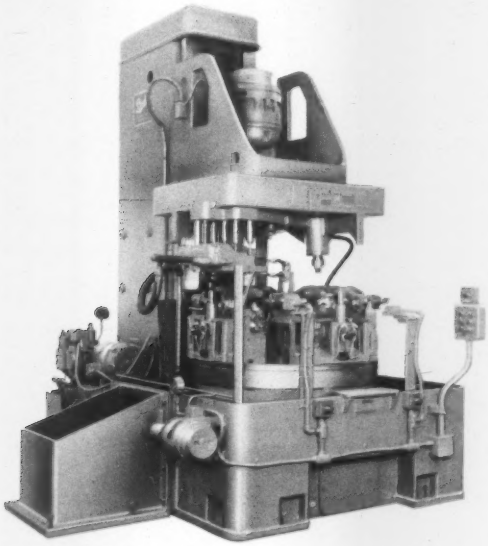
ORIGINAL: This 10-hp 6-station dial-index machine was the latest thing several years ago. It made power steering gear housings on a 33-second cycle.

Two recent exa can protec

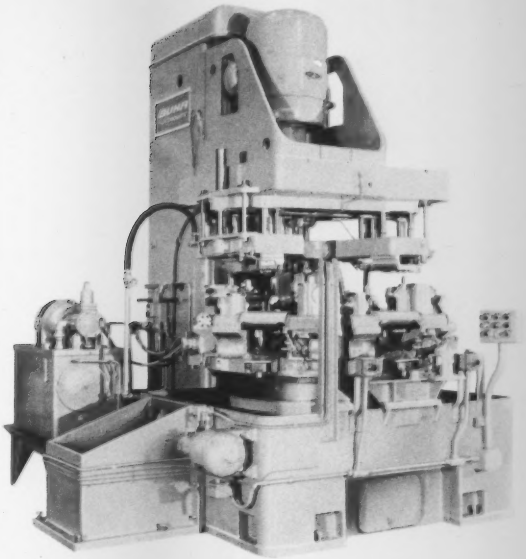
ORIGINAL: Three years ago, the then br machine was producing torque converter on a 23-second cycle. Plate blanks were one end of the machine and, after automa adapters came out the other end.



signed twice. The same produces it.



FIRST CONVERSION: Two years later, the machine was converted to a 4-station 15-hp dial, making somewhat different power steering gear housings on a 30-second cycle.



SECOND CONVERSION: Now, it is again a 6-station machine but with 40-hp main motor. Cycle time is still 30 seconds. The stepping up of power from 10 to 15 and then to 40 hp to keep pace with material changes illustrates the extra capacity built into Buhr machines. Conversion has simply kept it modern. Most of the original investment is still at work.

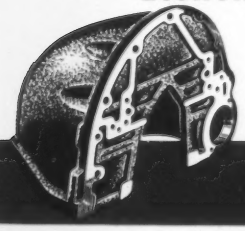
xamples show how *BUHR* convertibility ect your future machine investments

hen brand new Buhr transfer verter housing adapter plates were automatically fed into automatic operations, finished

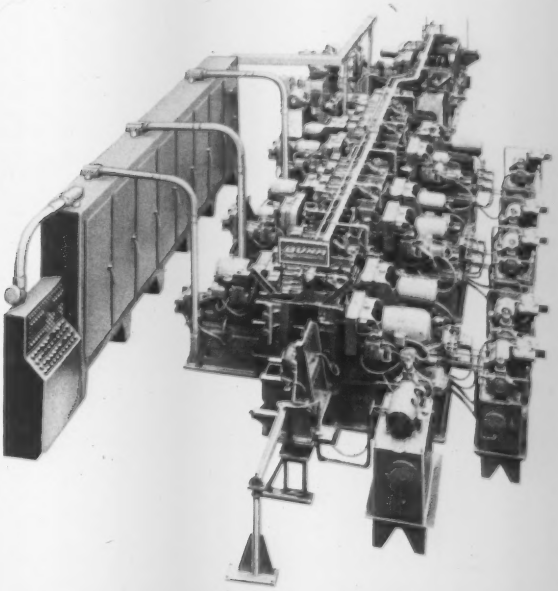
FIRST CONVERSION: When the "2-dimensional" adapters were discontinued, the machine was not retired. It was converted to making *three*-dimensional torque converter housings. Far from declining in efficiency, output of the Economatic was stepped up. Cycle time was cut to 14 seconds although the number of operations was increased to 94.

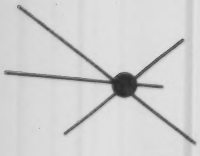
PRIOR TO 1958

on the same basic Economatic



NOW





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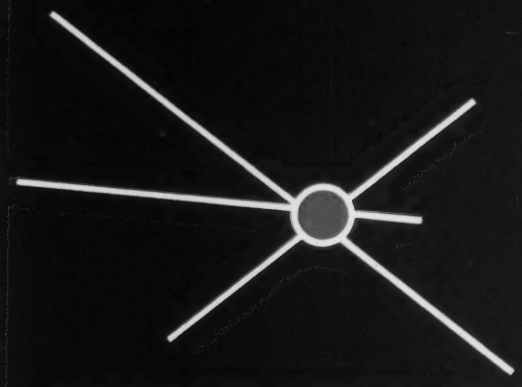


BUHR

the symbol of quality in multiple operation high and low production equipment

two examples

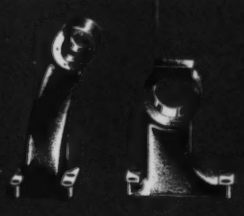
STEERING KNUCKLES

These tough steel steering knuckles must be machined carefully to prevent distortion. Two at a time come off a 16-station transfer after 26 operations.

Transfer Machine #C-4572

7 different road machinery parts are produced on one automatic machine. Settings for different parts are pre-selected with a dial switch.

Shuttle-type Machine #C-4552



ROAD MACH'Y PARTS

MANIFOLDS

Cast manifolds (both LH and RH) are produced at a rate of one every 21 seconds on a 20-station machine.

Transfer Machine #C-4524

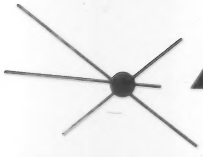
Connecting-rod caps are made from steel forgings in 12 operations on an 8-station dial-index machine. Four caps are finished in an 18-second cycle and they can be used without preselection.

Dial Index Machine #C-4965

CONNECTING-ROD CAPS

Typical jobs on various *BUHR* Economatics

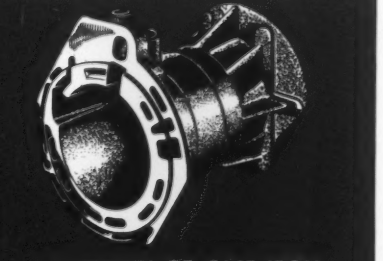
Any random selection is naturally incomplete. If you don't see a part that looks like yours, send us a part print and we will be happy to tell you what Buhr Economatics are doing to cut costs on your type of part.



BUHR MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN

Ask for more information by machine number



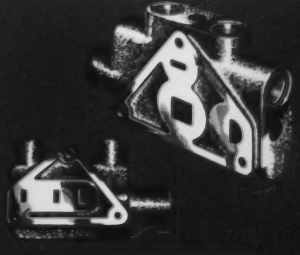
ALUMINUM OR CAST IRON

43 operations are performed on either aluminum or cast iron housings at 21 stations. Time cycle is 21 seconds per part.

Transfer Machine #C-4098

From 19 to 28 operations per part are performed on 32 different valve body styles on the same machine with only simple tool changes.

Trunnion Machine #C-5021



VALVE BODIES

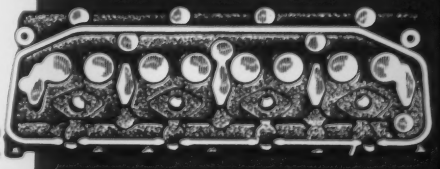
AXLE HOUSING

On this part, a short Buhr Economatic transfer machine has eliminated an annual retooling cost averaging $40,000 per year.

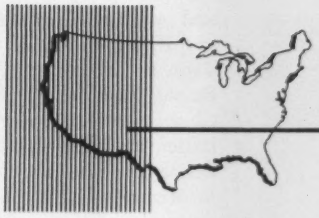
Short Transfer Machine #C-5188

All spark plug holes are combination drilled and reamed on a simple 2-fixture 4-station machine with a 12-spindle head.

Single-station Machine #C-4941



CYLINDER HEADS



western trends

By PATT PATTERSON
Los Angeles, Calif.

As missiles move from the research and development phase into quantity production, manufacturers are faced with the problem of upgrading production techniques. Convair has installed an automatic spray etching machine, built by Dry Screen Products Co., to handle printed circuits for Terrier and Tartar missiles. Unit automatically passes board through heated etchant spray for desired length of time and removes excess etchant by a water spray.

Transition Into Production

THE WEST COAST is home for a good number of the nation's electronics firms. And because of the demand for skilled labor in the aircraft and missile plants, the supporting electronics firms must insure that they get the most from their personnel. For this reason the West has been making long strides forward in automating processes which do not require human judgment and manual dexterity.

An example is the growth of the manufacturers which supply specialized equipment to the electronics firms. Ling Electronics, a major manufacturer of vibration testing equipment, has recently announced a semiautomatic test unit that eliminates a great number of the manual adjustments necessary with standard vibration test equipment. The Sine-O-Matic is designed for production line testing under the environmental conditions encountered in space.

As production runs become more common, manufacturers are finding that they must gear their assembly lines to routine procedures. Testing that was formerly confined to the laboratory must now be given production status. This is the role for which the Sine-O-Matic was designed.

Completely contained in one desk-sized console, a power generator and controls operate a remote shaker table, which can be enclosed in a soundproofed room if required. The unit has simplified controls and an efficient servo technique which keeps frequency and power levels at proper values through a wide range of settings. The operator merely sets the controls for the required tests and then places the device to be vibrated on the shaker table. An oscilloscope may be used to monitor electrical, electronic or electromechanical operation of the device under test, but for production line testing, a simple Go-No-Go instrument is generally used. Instead of highly trained technicians from the laboratory, production line workers can be instructed in use of the test equipment. The automatically compensating servo controls eliminate the multitude of precise adjustments formerly required for this type of equipment.

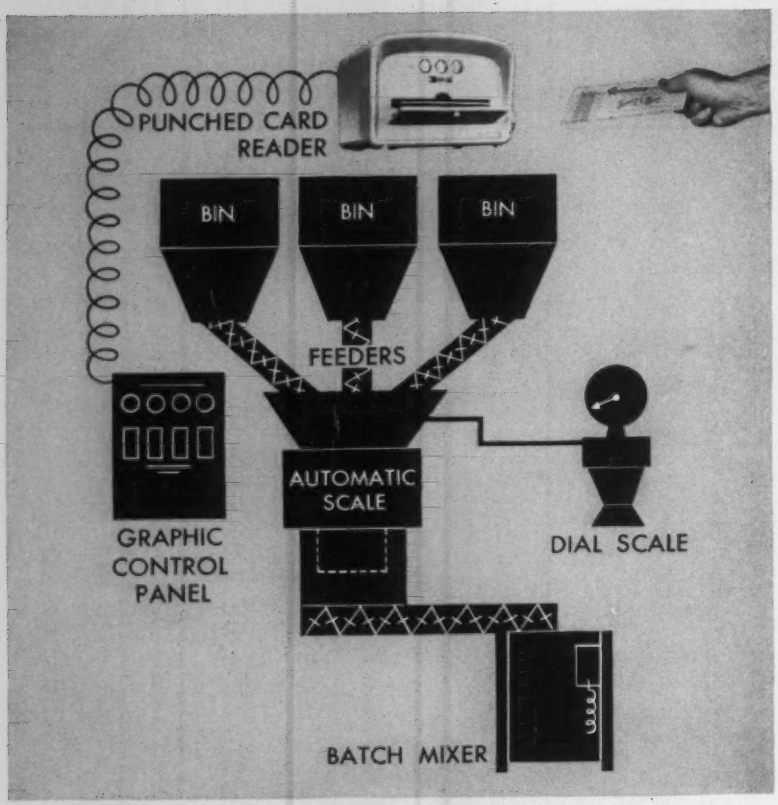
Circuit Etching

Because electronics has become a major part of missile building, a number of airframe manufacturers have established their own electronics divisions or subsidiaries. In some missiles, the electronics equipment comprises more than 60 per cent of the total cost of the project.

With more capital and know-how, the airframe makers have generally established modern, efficient electronics plants. Because of their familiarity with automation techniques in building aircraft and major missile structures, they tend to exploit these concepts in electronics manufacturing.

At Convair, a division of General Dynamics Corp., work has reached the production stage on the Terrier missile and pilot production stage on the Tartar. These two missiles are part of the Navy's Bumblebee project, and with the Talos, make up a combined surface-to-air missile defense.

The Terrier and Tartar will, when the Navy completes present construction plans, arm a total of 51 special guided missile ships. These will include two Forrestal class carriers, three guided missile (GM) cruisers, 19 GM frigates (a new class under a historical designation),



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and one nuclear powered GM cruiser—all to be armed with Terriers. This is in addition to the *U.S.S. Boston* and *U.S.S. Canberra*, guided missile cruisers presently operational, and the *U.S.S. Gyatt*, a GM destroyer. The Tartar will be used to arm one nuclear frigate, one nuclear aircraft carrier, 3 GM cruisers, and 18 GM destroyers.

With the changeover from prototype production to operational status, Convair's Pomona, Calif., plant, where the two missiles are assembled, has turned to mass production methods. One example is in the manufacture of the precise printed circuits for the miles of circuit wiring in each missile.

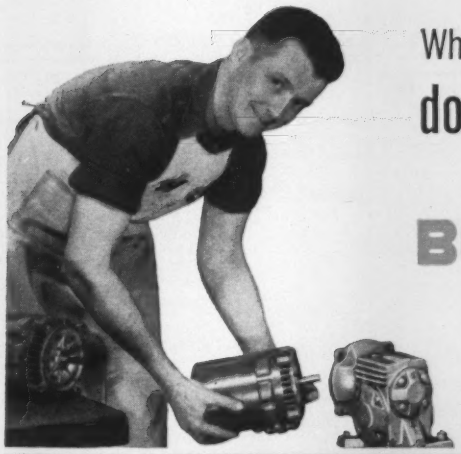
An automatic, continuous spray etching machine, first of its type installed on the West Coast, has been placed in operation in a printed circuit processing line. The machine, manufactured by the Dry Screen Process Co. is designed for economy with large or small scale production lots, but use at Pomona is scheduled for major runs.

Exposed printed circuit boards, approximately 12 by 18 inches, are placed in special hangers and loaded into the right side of the machine. A moving worm gear moves the boards between two banks of 12 spray nozzles, which spray heated etchant over either or both sides of the boards.

When the etching cycle is completed, the work passes into a water spray chamber which removes excess etchant. The racks are then removed from the machine manually.

With former rotary wheel, batch-loaded spray etchers, output of boards was 15 per hour. With the new automatic machine, the production has been increased to 45 per hour. Operation of the machine has improved the quality of the boards, increased the capacity of the processing section, and has greatly reduced production and maintenance costs at Pomona's printed circuit board department, according to **R. K. Stephens**, supervisor of the manufacturing development materials and processes engineering section.

As output requirements increase, the machine can be modified to accept automated feed devices, and both loading and unloading can become completely automatic.



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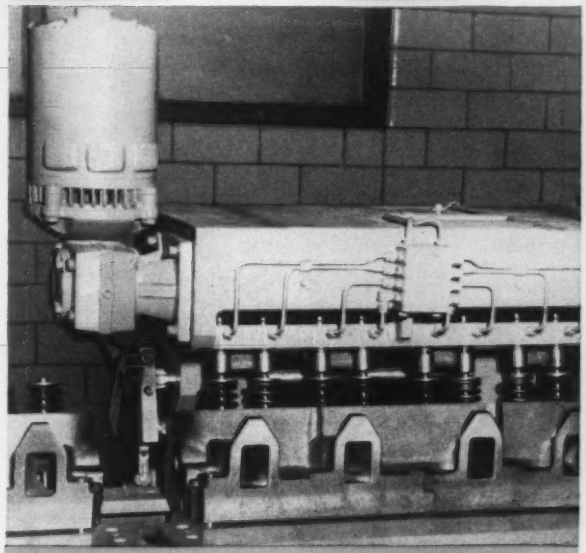

BOSTON Gear Vertical Right Angle RATIOMOTOR drives the valve "popping" (final test) unit in a giant 29-station transfer machine for continuous automatic assembly of cylinder heads.

BOSTON Gear Horizontal Right Angle RATIOMOTORS drive magnetic belts which convey parts from lower storage bins to vibratory hoppers at start of 13-station, automatic assembly of roller skate wheels.

BOSTON Gear RATIOMOTORS are the leading choice for all types of installations where downtime would be disastrous to production schedules. One reason is BOSTON Gear quality standards, which assure highest efficiency and extra service life of the gear unit. Another is BOSTON Gear design leadership like the detachable motor which permits continued operation with a spare, avoids downtime. Design around BOSTON Gear RATIOMOTORS for this *double* insurance against downtime. All types and ratios are *standardized stock* models, quickly available anywhere from over 100 BOSTON Gear Distributors. Boston Gear Works, 95 Hayward Street, Quincy 71, Massachusetts.

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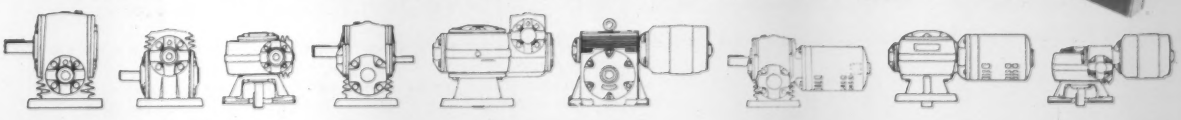

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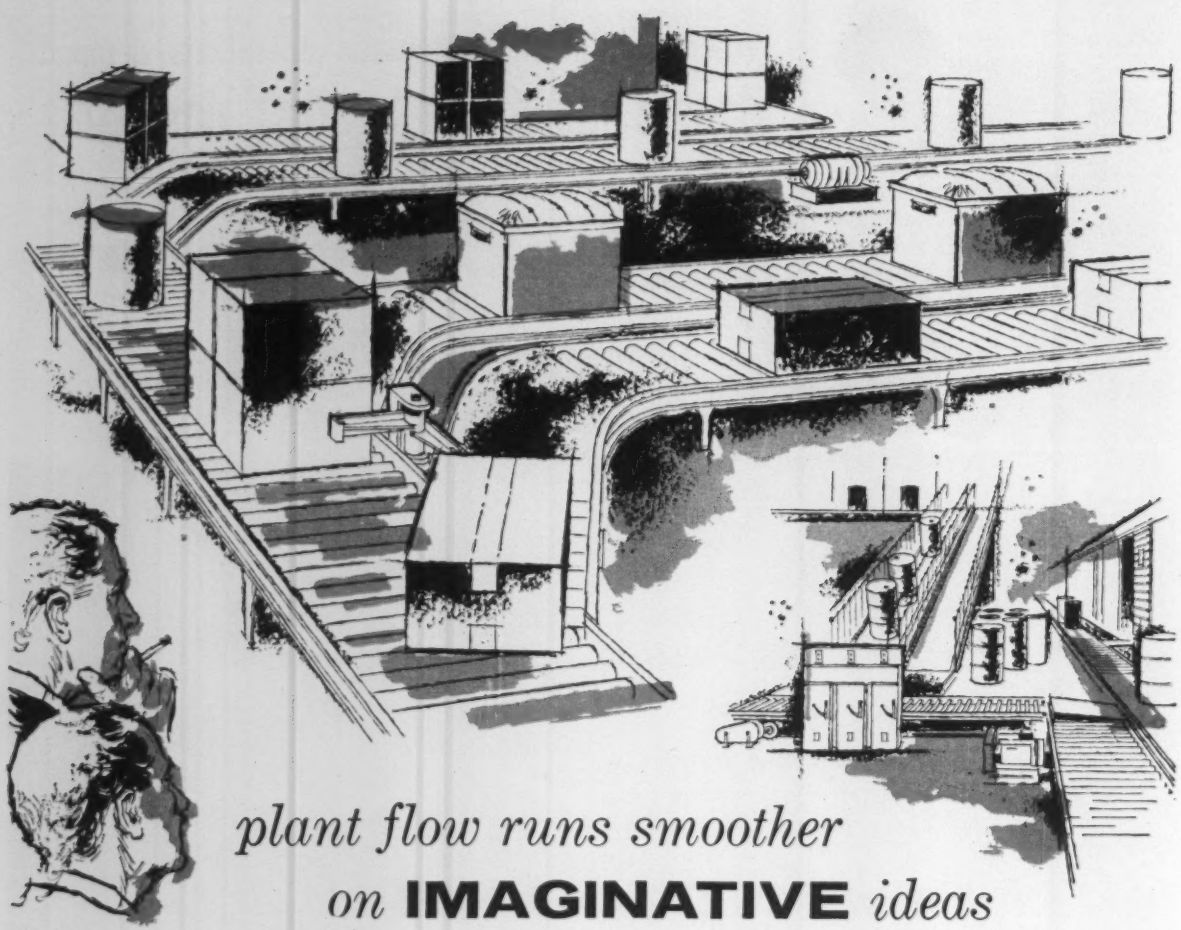

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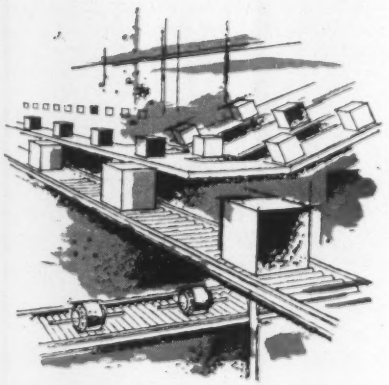

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By JAMES C. KEEBLER Managing Editor

George L. Weiser (left) the chief process engineer of Delco-Remy, a speaker at the Third Conference on Manufacturing Automation was photographed with Robert W. Ewald (center) manager of Special Machine Div., Gardner-Denver Co. and Robert C. Parker, engineer of Benerson Corp. as they paused for conversation in the Industrial Engineering Laboratory during the conference demonstration session at Purdue.

Art of In-Line Assembly

AN ENTHUSIASTIC group of automaters gathered at Purdue University for the Third Conference on Manufacturing Automation. Professor Ritchey took note of the fact that the participants had assembled from 20 states. In a well rounded program of general meetings, discussion groups, demonstrations, and after-dinner speeches the conferees took full advantage of this opportunity to learn more about automation from the speakers, the professors, and from each other.

The attendance record revealed wide representation from many different industries, and these makers of varied products by diverse methods expressed a realization that they experience many of the same kind of problems in achieving automation.

In addition to the broad considerations of organization and costs, the subjects covered included specifics in the areas of work-performing, handling, and control of automatic manufacturing operations. The three-day affair will be remembered for many highlights and top-notch presentations.

Speaking of Automakers

The conference tradition of the automakers turning in a well-received performance was upheld by George L. Weiser, chief process engineer of Delco-Remy Div., General Motors Corp. Coming from a division internationally known for its development and use of automatic assembly equipment, Weiser's 27 years of experience place him in an exceptionally good position to deal with the subject "Assembling Complex Devices." Implementing this talk was a movie of the same name prepared for premiere showing at this conference. The main theme covers the use of a basic in-line transfer-type machine with a chain around a table. Many different variations on this theme have been tooled to produce a wide variety of automotive ignition equipment.

The conference schedule provided times and places for discussion group meetings which enabled small groups of participants to get together and bring out points of individual interest. The Weiser groups proved so enthusiastic that their request for a rerun of the film was accommodated in the final period.

The liveliness of some of these discussions bore out the conference committee's contention that it is easier for the individual to get his two cents worth in a group of 20 than it is in an auditorium full of people.

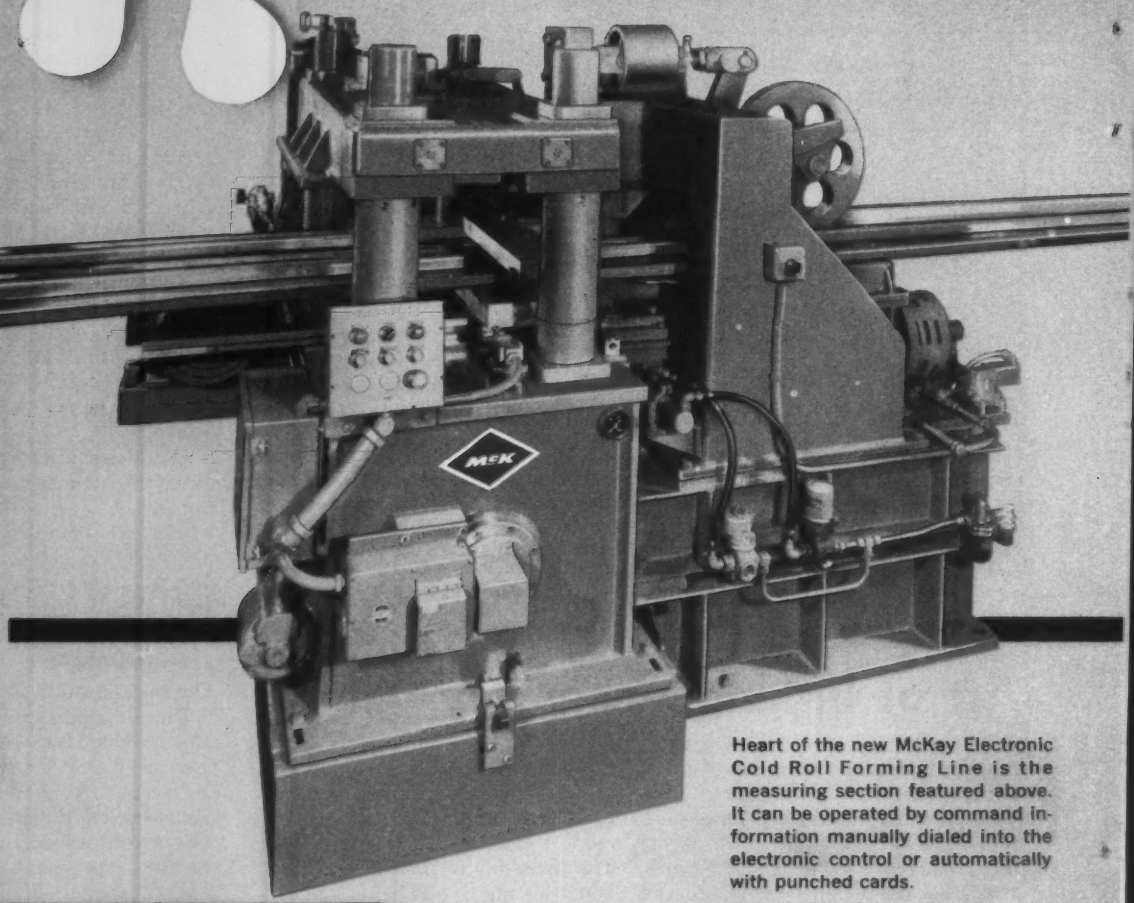
Questions answered and points discussed in a typical group meeting give a good insight on the interests of some conferees in this phase of the subject, and indicate also a "state of the art" condition with regard to current industrial practice.

Organization and Costs

Process engineering personnel at Delco-Remy Div. number in excess of 300. Of these about 47 per cent are graduate engineers. Fourteen are designers working on the board, making drawings of production equipment. Others have various specialties such as welding, plastics, cold working, feeding, etc. Production equipment is developed on expense budgets which allow for the cost of current projects. When a machine is ready for production a project appropriation is arranged and a machine cost estimate to build the equipment is made. The machine is capitalized for that amount.

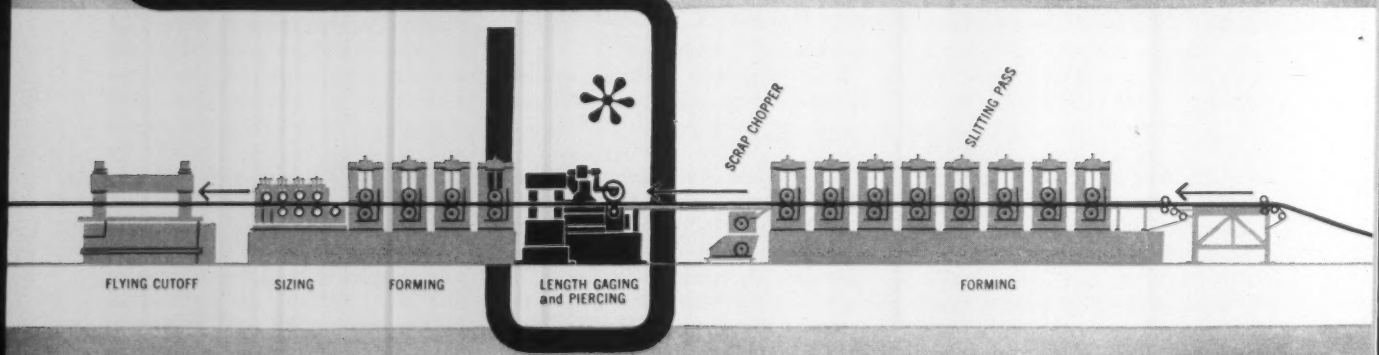
Since the division's products are sold competitively to the automotive and allied industry the decision on how automatic the production will be is to a degree made by the customer. The sales force and product engineers are cost conscious. Their customers get a price based on the method of manufacture. So

10,001



Heart of the new McKay Electronic Cold Roll Forming Line is the measuring section featured above. It can be operated by command information manually dialed into the electronic control or automatically with punched cards.

(Patent applied for)



The line illustrated above was recently purchased by a large building products manufacturer for high speed production of roof and floor deck.

different lengths...

...WITHOUT A MANUAL ADJUSTMENT

McKAY'S ELECTRONIC LENGTH GAGE has a memory permitting instantaneous changes in cut lengths and scheduled quantities as well as precise control of notch and punch spacing on each length.

A transistorized electronic control reads and stores information from punched cards and utilizes an electronic counter to trigger a punching and notching press at precise intervals as commanded by the coded data on the punched cards.

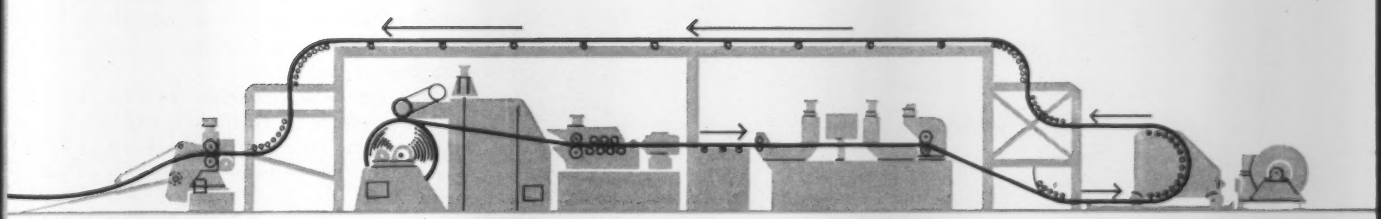
Now! the planning department can schedule the output of a forming or cut-up line without waiting to group identical lengths.

Now! down time previously required for manual length gage adjustment is converted to productive time.

Now! in addition to length control, precise spacing of notches and punches can be controlled and changed by commands received from coded information on the standard data processing card.

BE SURE TO GET THE FULL STORY ON McKAY'S ELECTRONIC GAGE FOR YOUR PRODUCTION LINES.

Call or write the McKay Machine Company, Youngstown 10, Ohio.



McKAY McK MACHINE

Circle 687 on Page 17

much per item for method A with one cost of equipment. So much per item for method B with a different cost of equipment. The basic in-line machine for example costs $7000.00 and the customers often specify this type of equipment to be used for their parts.

Equipment

On an in-line machine of the type described, workpieces are transferred from station to station in nests fastened to the chain. The chain is intermittently indexed upon the completion of all stations' work functions. Variations and stretch in the chain are accommodated by either lifting the part out of the nest at the workstation and seating in a pilot surface on the tooling above, or allowing the nest to "float" on the chain and be accurately located at each work station by shot bolts that function as part of the tooling.

Ordinarily tooling at the various stations consists primarily of standard equipment. That is to say where a screwdriver or a riveter or welder is required this item is purchased as a standard unit and integrated into the assembly machine rather than designed specially for the job. Otherwise, however, most of the attachments peculiar to fabrication of a given workpiece are designed specially for that job.

The machine has a standard indexing unit in the base. This drives the chain. The base also encloses a camshaft which runs through the center and is used to actuate valves and limit switches to achieve the automatic cycle.

Feeders

Parts feeders are one item that are not designed on the drawing board. This is model shop work of toolmakers who specialize in being able to feed all sorts of parts. The vibratory bowl type unit is popular and standard bases are fitted out with stainless steel bowls. Where it is impossible to devise reasonable methods for feeding certain parts economically, operator stations to manually feed the part are included in the design. Because of the specialized nature of the work certain types of parts become the long suit of certain individuals and the success of a feeding device often hinges on the right man coming up with the right idea.

Where orientation is critical and jamming of off-tolerance parts likely, special sorting feeders are used to separate good parts from bad prior to putting production lot runs through the assembly machine. This practice saves much downtime.

Operating

This type of equipment is figured to yield a cost saving when operated at 80 per cent efficiency and is expected to have no more downtime than would give this reliable level of performance.

When a new machine is ready for production it is placed in a preproduction area and scheduled to run with production parts, and production operators from the plant and department where it is destined to operate. Maintenance personnel are also trained during this period. The training period is important on the new equipment. It is recognized that the biggest bug that can get into such a development is a negative attitude on the part of those involved in the project.

In actual production the machine may have operators to feed parts and also a "Utility Man" to keep this, and several other, machines running by supplying parts and freeing any jams that may occur. The utility man may do minor machine repair to the limit of things that can be done without going to a tool crib.

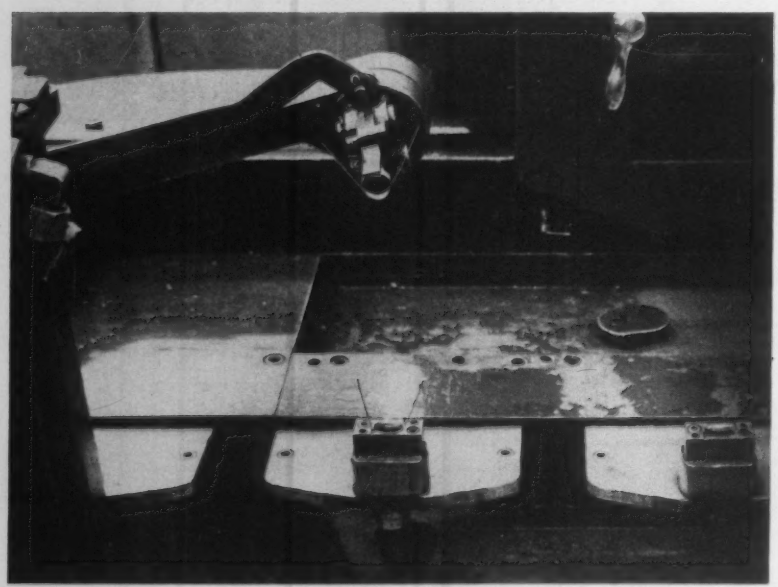
Components

Participants in these discussions contributed ideas about components available. Accelerated tests of valves and switches may prove of value to engineers in this business. The choice of reliable components is important. Nylon tubing is being used for air lines to pneumatic equipment and reported highly satisfactory by several. The need for a good momentary electrical contact limit switch with sustained mechanical contact was expressed.

Training

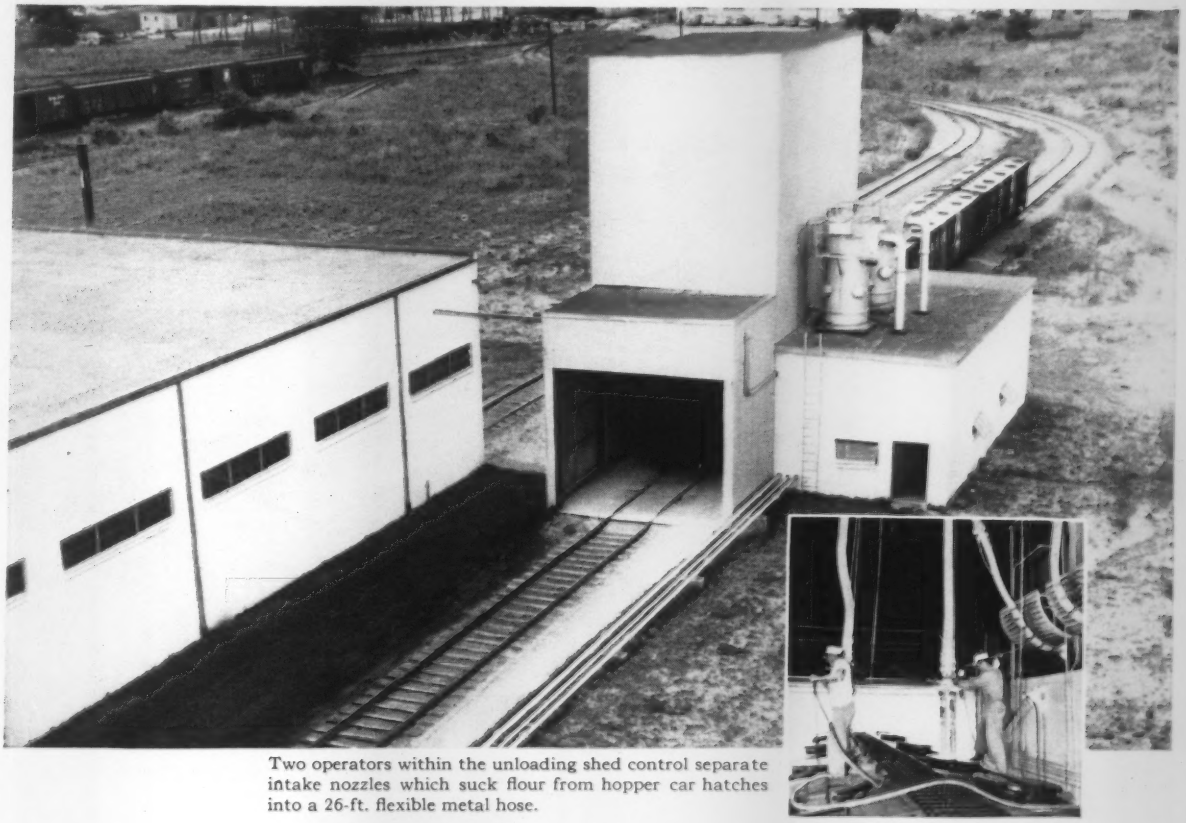
The need for broader training was recognized. Specialists in welding, plastics, etc., become qualified manufacturing engineers by serving a term on the design board and rotating to other specialties. The automation challenge has called for a new breed of cat—a good mechanical man that's not afraid of electricity.

George Weiser summed it up by advising the automaters not to get scared and stop too quickly.



One of the machines developed and used by Delco-Remy Div. makes a resistor winding and clip assembly. Because the wire is soft and easily deformed in handling, the coil is wound at a station of the assembly machine. Here a coil is shown being automatically transferred from the winder to a nest in the in-line transfer-type machine.

The Arithmetic of Materials Handling



Two operators within the unloading shed control separate intake nozzles which suck flour from hopper car hatches into a 26-ft. flexible metal hose.

Flexibility of FULLER Pneumatic Conveying Systems Makes Problem Plant Site Practical For General Mills

The proposed site of a new General Mills flour blending and packaging plant in Louisville, Ky. seemed impractical to mill engineers because of the site's long, narrow shape. Flour, delivered at a dead-end rail siding, would have to be conveyed over unusually long distances—400 feet from unloading point to storage bins.

By incorporating Fuller Airveyor® pneumatic conveying systems in the plant design, General Mills has overcome these disadvantages and has completed one of the country's most modern bulk flour handling plants.

At the new, highly-automated plant, Fuller Airveyors unload Airslide® or hopper cars of bulk flour at 40 tons an hour, flowing it 400 feet to a series of 18 silos. In a completely integrated system, other Fuller Airveyors deliver ingredients for blending, weighing, proportioning and bagging operations. The compact, 5-inch pneumatic pipelines twist and turn easily through what would be cramped or impossible quarters for other methods of conveying. Self-cleaning Airveyors, containing few moving parts, practically eliminate maintenance and industrial hazards.

Production speed, flexibility, sanitation, processing accuracy, push-button control of an entire plant—are just some of the advantages of Fuller pneumatic bulk handling systems realized at General Mills' new Louisville plant. Similar advantages can apply to old plants modernized with the help of Fuller engineering specialists. Write or phone today outlining your problem. Fuller will gladly furnish additional information with appropriate recommendations.

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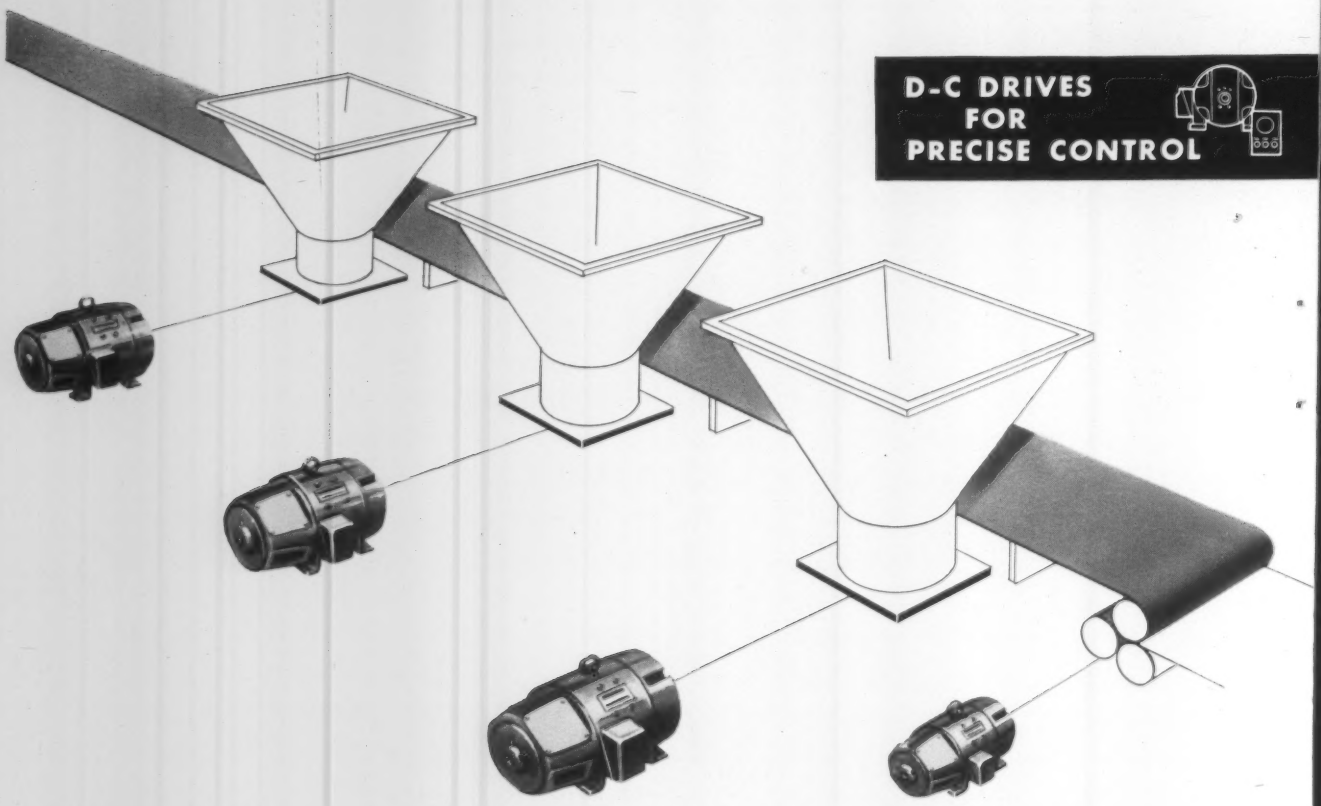
Circle 688 on Page 17



D-C DRIVES FOR PRECISE CONTROL

Problem: How to control machine speed ratios for accurate proportioning, continuous flow

Keeping the blend accurate in proportionate mixing requires a high degree of machine coordination. Inaccurate speed matching of mixers or conveyors can result in poor product quality, inaccurate measure, wasted material.

ACCURATE SPEED MATCHING IS A NATURAL JOB FOR DIRECT-CURRENT POWER. For only direct current can provide the split-second response, wide speed range and precise control vital to modern, automatic machines.

If you are planning to upgrade your production facilities to make processes more automatic, it will pay you to investigate the role direct current can play. A new booklet, "WHY D-C?," is available to help you. For your free copy, write *Section 829-2, General Electric Company, Schenectady 5, N. Y.*

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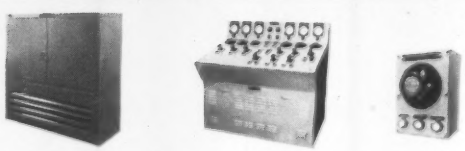


POWER UNITS AND CONTROLS

Foggy Greek

Speaking of developments in the area of data processing, one authority recently wrote that there is "a growing popularity of Greek." His allusion to the mystery and the fog of electronics with which the "high priests" of data processing have enveloped the subject gives cause for reflection.

As always, some of the fog arises from simple failure of zealots to see the big picture. Data processing is developing on many fronts and, quite naturally, all those involved see their contribution in a somewhat different frame of reference.

Although commercial office application to date has been noteworthy, most significant with regard to data processing is its growth and growing importance in the industrial scene. Here we find an increasing shift of data processing into closer relationship with manufacturing operations. This, after all, is the point and purpose of information in the industrial enterprise—to make possible efficient use of manufacturing facilities.

The pressing need for cost reduction and elimination of waste makes it imperative that production operations be closely integrated by means of suitable data handling facilities. Just as surely, the engineers who plan and install the manufacturing systems are being called upon to plan for the data processing needs of the over-all system. Applications run the gamut from ticket handling systems to equipment for manufacturing order handling, production planning data, machinery monitoring costs, production efficiency, plant-to-plant scheduling operations, inventory control, and process control, to name but a few.

Just as automation has obsoleted the departmentalized approach to manufacturing, so too it will obsolete the office as an isolated entity. Data processing for the modern enterprise will become another closely integrated segment of the over-all manufacturing system. All forms of equipment will find their useful places in this newly evolving approach.

The fog will eventually clear, but some clear thinking and broader understanding by those closely associated with these developments will hasten the day.

EDITOR

AUTOMATION

Fig. 1—Inventory in Rapids-Standard plant was reduced by 1/3 as result of storing items at point of use. Incoming small parts for conveyor manufacture are moved directly to tiered racks adjoining assembly area by transfer mechanism carried on forks of lift truck. At delivery end of racks are assembly stations where parts are combined with bearing wheels that are delivered to the assembly point by overhead belt conveyors.

MATERIALS HANDLING

A KEY TO AUTOMATION FOR SMALL COMPANIES

Mechanized handling in many of the basic supporting operations in the smaller company provides real dollar savings. Although production quantities are modest and variety high, a program tailored to the problem can be extremely effective.

By **JAMES R. SEBASTIAN,** President, Rapids-Standard Co. Inc., Grand Rapids, Mich.

A STUDY of profit data discloses a considerable disparity in the "after-tax earnings" between small corporations and large corporations. The extent of this disparity is shown in TABLE 1, which is summarized from a recent report of the Securities and Exchange Commission Quarterly Financial Report.

Present profits for small and medium sized companies are not adequate to sustain the necessary growth in an expanding market. But small businesses do not have ready access to low cost capital—they must earn their capital needs. What, then, can smaller businesses do to increase their earnings and bring them more into line with the percentage earning on sales realized by larger companies? The answer: Small and medium sized companies can borrow large businesses' "management approach" to automation.

As a point of reference, we need a definition of automation understandable to small companies. A sug-

This article is based on a paper presented at the "Third Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, March 1959.

TABLE 1—After-Tax Earnings on Sales

PERIOD	CLASSIFICATION BY ASSETS				
	Up to $1 Million	$1 Million to $10 Million	$10 Million to $100 Million	$100 Million to $1 Billion	Over $1 Billion
3rd Quarter 1957	2.2%	3.45%	4.05%	4.75%	7.9%
4th Quarter 1957	0.35%	2.35%	4.10%	4.85%	9.0%
1st Quarter 1958	0.05%	1.65%	3.25%	3.85%	7.0%
2nd Quarter 1958	1.05%	2.5%	3.55%	4.2%	6.9%
3rd Quarter 1958	2.05%	3.25%	4.10%	4.6%	7.7%

gested definition: Doing more things automatically and more efficiently than we are now doing. This presents automation as a practical and a rugged way of doing things, and avoids the sensationalism of the popular press. Even though there is great fear that it is impractical and costly for small business to seek efficiency through automation, this need not be the case.

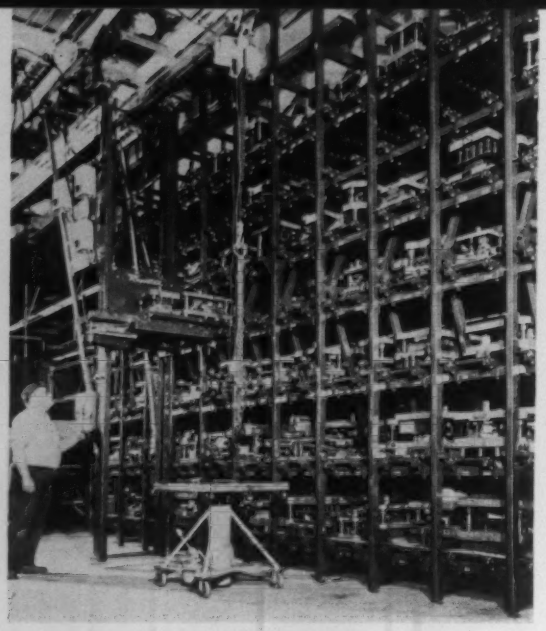
▶ Three Functions

The functions of automation are: 1. Processing. 2. Materials handling. 3. Controls. Controls are for the purpose of integrating the functions of processing and materials handling. It is possible for the management approach to each of these functions of automation to be simple, and to be geared to small company needs and abilities. This approach need not be elaborate. The proper management of processing, materials handling and control functions in small companies is often neglected. We have long realized this because of our experience in the application of materials handling equipment with small companies. Of the three functions of automation, improvements in the materials handling function can often be the most effective and profitable.

I believe that of the three functions of automation, those of materials handling and controls have been neglected more than the function of processing. In the past, the machine tool industry has placed great emphasis on higher cutting speeds, on lathes with higher horsepower, and on presses with greater speeds and tonnages. There are authorities outside of the materials handling field who maintain that the largest single area for cost reduction is in materials handling. A long time ago, there was a period when dramatic results could be obtained through the purchase of a single tool or a piece of equipment within a department. The day of great benefits from single pieces of equipment, either in processing or in handling, has passed. Many of the simple and obvious applications have been made. Today's competition, higher costs, and need for efficient, low cost production demand the systems, or management, approach to materials handling. This is the approach of "supplier to customer." In the systems approach, it is realized that materials handling problems start in the plant of the supplier, and these problems do not end until the product is in the hands of the customer.

I would like to quote one of the consultants in the materials handling field, Mr. James Bright: "In examining some 600 plants over the last 8 or 10 years, one interesting difference, it seemed to me, marked the better manufacturing operations from the poorer ones; that is, the extent to which materials handling is regarded as an integrated, plant-wide function. In plants with weak handling systems, the handling engineering is spotty, with little relationship to overall plant requirements. Man-

Fig. 2—Outside dock area of existing plant was enclosed to obtain this storage space for electric motors. Other motors are stored at point of use within the plant. Surge storage racks and side delivery from a fork truck transfer device make it possible to use the 10-foot wide room as a major storage area.



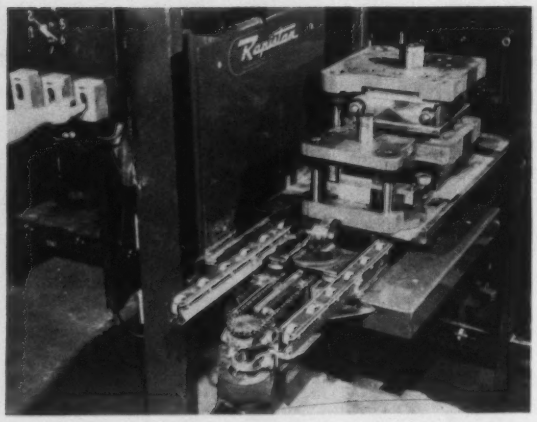


Fig. 3—Die storage rack provides good economy of floor space. Dies rest on thin steel pallet. Control panel allows operator to select desired storage location in transferring dies in and out of rack. Note that transfer machine is suspended on overhead trolley track.

agement and material handling men must recognize that efficient handling is not a department-to-department problem. It is a vendor's-plant to customer's-door problem. The best handling systems are those that recognize this full cycle. Materials handling begins when material reaches the receiving dock. Therefore, the wise material handling engineer works first with his purchasing agent to insure that this material arrives in optimum manner, timing, and form. This same philosophy should extend throughout the plant, so that one does not construct an unco-ordinated and unrelated sequence of handling techniques."

After all of the simple production improvements have been employed—a new tool here, a new material handling device there—the time arrives for a more sophisticated approach to the problems. Materials handling is often the most logical candidate for maximum cost reductions in small companies because of previous strong emphasis upon processing operations. Materials handling provides the mechanical linkage, and the mechanical storage between supplier, processing equipment, warehousing, and finally the customer.

▶ A Case In Point

I would like to present as a case history, the experience of The Rapids-Standard Co. Inc., a manufacturer of materials handling equipment, in the use of materials handling equipment and controls in its own operations. Prior to 1948, the company operated in multistory plants, with severe operating handicaps. In 1948, a new plant was built, and in 1952, an addition larger than the initial plant was made. We had long dreamed of one story plant efficiency. On the surface this should have resulted in more efficient production. In spite of a large capital investment, however, we ended up with higher costs and lower profits, a pattern repeated countless times in all industries. All of the labor saving equipment we employed did not make a sufficient gain in efficiency to produce satisfactory labor savings because something was lacking.

We wondered whether or not in this job shop type of business of ours we had gone too far in labor saving equipment, the very equipment that we manufacture. We asked the questions, "Were we in an area of marginal returns in this job shop of ours? Was it an intrinsic characteristic that methods and products for mass production could not be applied within our own industry?" It took a long and painful experience to teach us that the keystone was co-ordinated effort. We were solving individual problems, but the inter-relationships of these separate problems were not being considered properly. In effect, every time we solved a problem in one area, we created a new problem elsewhere. Then the realization came that the proper use of capital equipment requires a complete co-ordination of all the skills of management in all of the departments—purchasing, finance, accounting, work methods, standards, production, engineering, sales, and industrial relations. All of these departments must participate to some extent in the enterprise's material handling program, if the program is to be successful, and if the profit opportunities inherent in the program are to be realized.

We discovered that materials handling had a bearing on all management activities. Materials handling was a single element common to all. It was the means of unifying and co-ordinating our efforts. It was also the means of dramatizing our program and, as such, it served as a catalyst.

Three years ago, we launched a program of internal improvement in management, and in the use of the present and improved material handling equipment. For want of a better word, we called this "The Program". Then one day, I mentioned in dic-

tation, "The *techniques* of the general industrial arts". I had a new secretary. The letter came back with the spelling, "The *technics* of the general industrial arts". I questioned the secretary on this spelling of the word. The reply was, "Mr. Sebastian, in the sense that you used the word, 'technics' is the word that I thought you wanted to use." A dictionary definition of technics is: The study and science of the general industrial arts. It is a rich, old, root word. "The Program" had a name! For us, "Technics" was an exciting adventure in profits. Technics is little other than the management approach of large companies to the problems of processing, materials handling and controls. A technics program calls for action across all lines of the company. Technics is the co-ordination of general industrial arts through materials handling to increase the efficiency and the profit of the operation. Technics succeeds only as top management gives leadership to the program. With us, Technics was a name for an internally salable program of intensive improvements. The central direction of Technics was that of material handling and the management of material handling. We learned from this program that materials handling in turn will be the most dramatic proof of good management. It is second in importance only to the balance sheet.

To a degree I can describe the Technics approach through criticism of our industry and our company. The criticism was made, "Your industry promotes the idea that a customer had a problem, and that the problem was solved by a piece of equipment with startling results. This is a surface treatment of the problem. It is not complete. Your industry should point out the need of analysis, of study, and of the need for adequate controls and methods. It is only after this course of action is followed that equipment can be prescribed. The equipment, together with the proper management of the equipment, will give the result. All you do is furnish pills. You do not go after the disease! You push the problem around." The criticism was correct. Technics is a program of better use, application, and management of equipment. This program calls for the full integration of equipment within the total scheme of manufacturing, storage and sales.

Program Details

In our work with Technics, a formula was developed that has helped to bring this approach into better focus: $TM\ (a\ c\ m\ e)\ ms^2 = \epsilon^n$.

TM is top management. Top management leadership and participation in a technics program is essential. The technics approach to materials handling calls for action cutting across all departmental lines of a company. The only people who can cut across departmental lines are people in top management. The assignment cannot be delegated down the organization setup. The materials handling function in any company must have top management support to bring together diverse interest, to resolve conflicts, and to make changes.

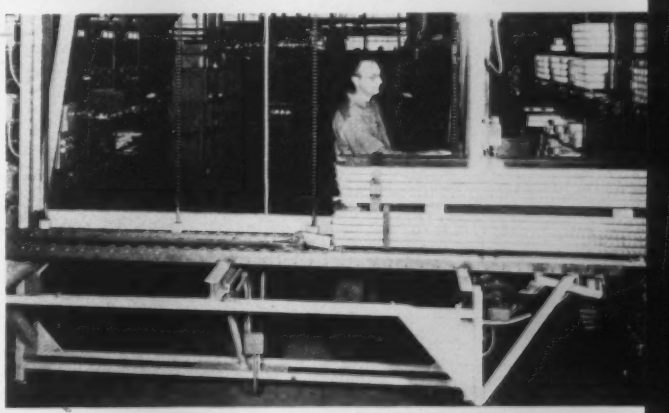


Fig. 5—Long, roll formed shapes create a major handling problem in view of the quantities which are produced. Parts are bundled together and stored on thin steel pallets in live racks. Shown here, bundles are moved to the rack area on a mechanized carrier equipped with a dog mechanism that pushes the bundles into the racks.

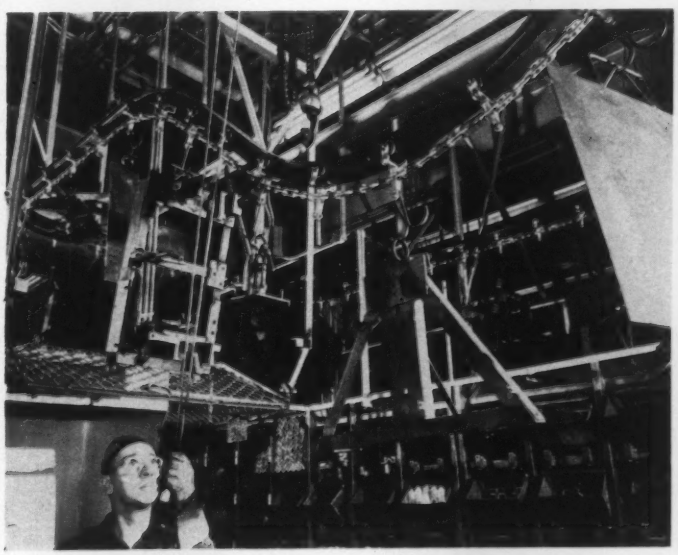


Fig. 4—Unusual use of overhead trolley conveyor in welding area solves a knotty problem. In this arrangement, welding jigs and fixtures are stored on the conveyor and, as called for by operator, are delivered to dipped section of conveyor. Improved storage for the fixtures made it economical to set up for smaller production runs.

In this area of top management, it is interesting to note some of the influences of automation upon the thinking and the action of top management. I think the statement of Mr. Clarence H. Thayer, vice-president of Manufacturing of the Sun Oil Co., is of interest.* In discussing the operation of a new

*C. H. Thayer—"Applying An Automation Philosophy"; AUTOMATION, Vol. 6, No. 1, Jan. 1959, p. 46.

refinery at Sarnia, Ontario, Mr. Thayer says, "In this refinery all of the men except laboratory technicians and accountants are part of a single operating team . . . the operating department. The men were trained somewhat as the crew of a submarine. They are not concerned whether someone else is doing their work, or whether they are doing someone else's work. . . . the employees at Sarnia have a wider scope of responsibility."

I think one of the implications of this statement and of our experience in connection with the management approach to technics and to automation is this: It is essential for management to lower the fences between departments. Top management must work to lessen the prerogatives of specific jobs or departments. Greater flexibility of mind is required of the operating department. Top management must work to develop a tolerance and an understanding between people that will allow operations beyond the normal confines of job descriptions and responsibilities.

In addition, it is obvious that top management must do a thorough job of selling the organization on the need for changes in basic philosophies, policies, methods, and procedures.

Although one of the criticisms of automation has been that of rigidity, there are compensating areas of flexibility in the "operating department" idea of Mr. Thayer. The changes brought about by automation benefit the individual as well as the organization. Top management plays a vital role in the preparation of an organization for change. For these reasons, the algebraic formula is shown with top management (*TM*) as a multiplier of the other parts of the technics equation.

The *a* in the formula represents analysis and planning. This is the painful period of preparation. Our own experience with two programs, one near completion and another just underway, as well as our experience with customers, shows that far more time will be required than expected for proper analysis and planning. Crash programs are not recommended for maximum gains. It is seldom that a single change can be blended into surrounding static conditions. More often a series of changes are required affecting several departments at the same time. Changes are always time consuming because of the need of people to make adjustments, to learn new methods, and to establish new ways of working with adjoining departments.

The c in the formula represents controls. Controls provide the means of integrating processing equipment and materials handling equipment. Adequate controls are essential to effective management. Controls are the tools that nail down the gains of improved equipment and tools. This is a vital area. Our experience in working with customers is filled to overflowing with examples of fine equipment and systems that were well-conceived, but which do not bring full results to the owners because of failure to establish adequate controls. The full po-

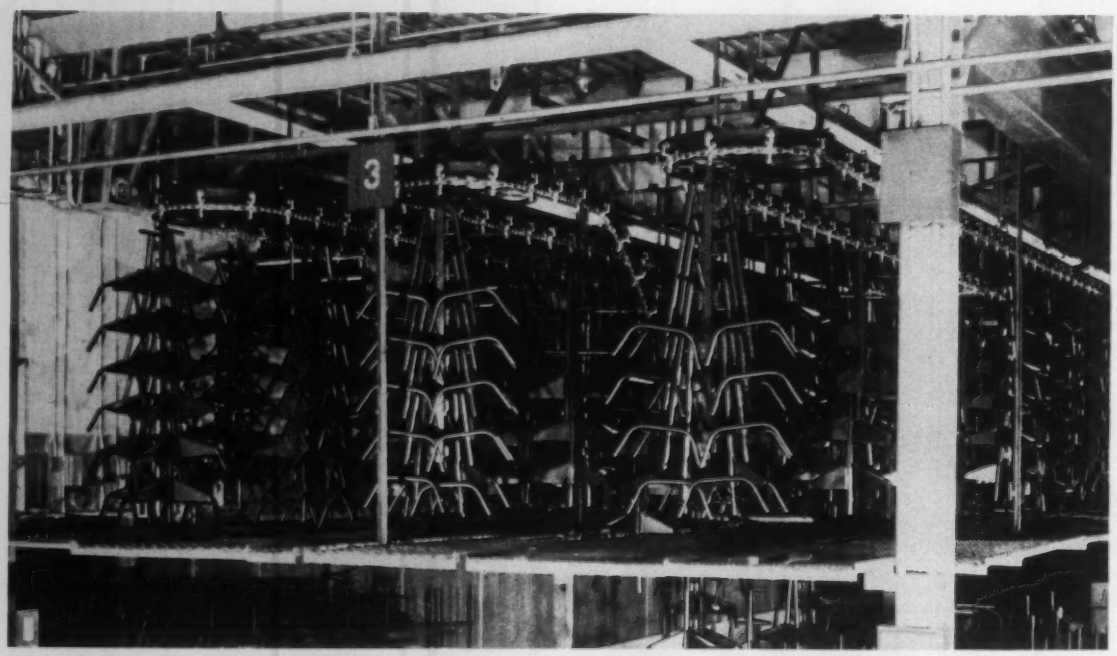


Fig. 6—Efficient use of overhead space is achieved for conveyor stand inventory with use of Rapistan-Keystone trolley conveyor. System stores a maximum quantity of the odd shaped items in the least amount of space.

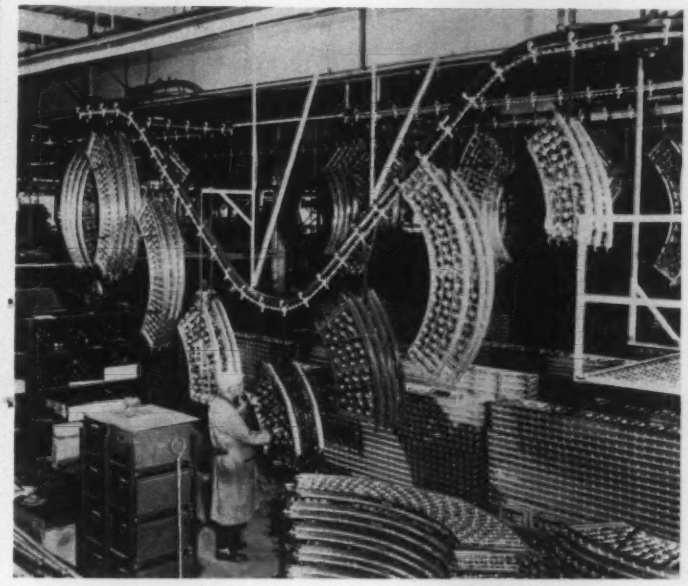


Fig. 7—Inventory of curved conveyor sections is stored on overhead accumulation lines. As shown, order selector can remove required sections from the dip point in the overhead line. This selection center is located adjacent to the shipping dock.

tential of new equipment in systems will not be reached unless adequate controls are established.

The *m* in the formula stands for methods. It is necessary that comprehensive methods work be carried on during the period of change. Supervision and operators must be trained in new methods. All too often, new equipment is installed and is operated with old methods. Methods work is necessary to establish the standards under which new equipment will operate.

The *e* in the formula represents equipment. It is only after adequate analysis and planning, controls, and methods work has been accomplished that equipment should be prescribed. It is not easy for a manufacturer of equipment, who loves orders, to make this assertion. This statement is made, however, in the belief that if the proper planning, controls, and methods are first established, the market for equipment will be far larger than it could be without such a base. Our industry will perform a better service and the sales of our industry will be larger in the long run. As a technics program gets underway, the materials handling equipment becomes the physical embodiment of beneficial change and progress. It is dramatic evidence of improvement and of good management. As the first segment of a change is made, this segment can be of great assistance in selling and quickening the rate of change in the rest of the organization.

The term ms^2 refers to middle management and supervision. This vital group is also shown as a multiplier in the equation. These are the people that must carry out the functions of analysis, control, methods, and equipment. Their efforts can be multiplied by the leadership of top management. This group of middle management, if fused together in a cohesive, enthusiastic group, will provide results that will be the "square of the effort".

The last term in the formula, $¢^n$, is an effort at a light touch in describing the results that can come from this management formula. The results can be dramatic! Cents to the *n*th power! Although this formula is presented as a management approach to materials handling, it is also obvious that it provides a management approach to further effort in the field of automation for small companies. The formula is effective.

Impressive Results

As an example, there is the case of a company of the small to medium size class that was considering an equipment purchase of approximately $100,000. Initial steps of the formula were followed in planning the use of the equipment. A medical term, "preoperative care" could be used to describe this stage. Several months were used in planning. New controls and methods were established and were given limited use prior to the purchase of equipment. To the amazement of our people and the customer, it was disclosed that annual savings amounting to $20,000 had been made without any changes in the physical layout of the plant, and before purchase of equipment. This allowed a larger than anticipated down payment on the purchase.

The illustrations accompanying this article highlight the improvements made at our own plant as a result of our Technics program. We have often been referred to as "the shoemaker who finally made shoes for his own children." A program of this nature would not be worthwhile discussing unless there were results from that program.

1. We gained 40,000 sq ft of floor space within the existing plant (120,000 sq ft) with an investment of $100,000 in capital and expense items. This eliminated the need for a planned $300,000 building program.

2. Inventory was reduced by approximately 1/3, or $600,000, through better controls in purchasing and material control and through the concept of "storage at point of use."

3. The productive capacity of the plant was increased by 50 per cent without the addition of space, manpower, or machinery.

4. The program was paid for by savings effected within the year in which it was put into effect.

5. Space (8000 sq ft) was made available for finished goods storage. This enabled the sales department to make rapid shipment on high turnover items.

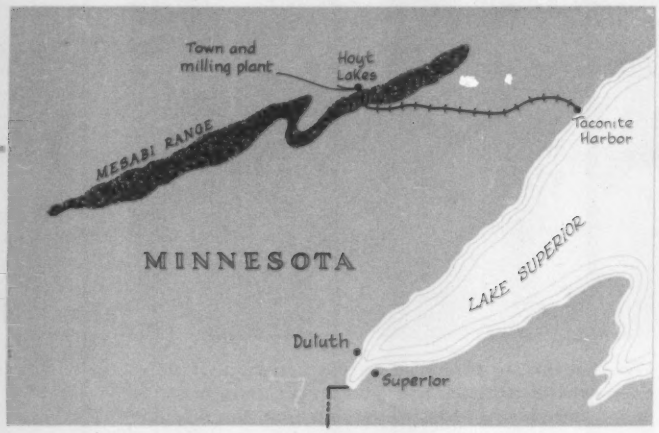
6. An additional 8000 sq ft of space released from the plant was used to expand the sales engineering department.

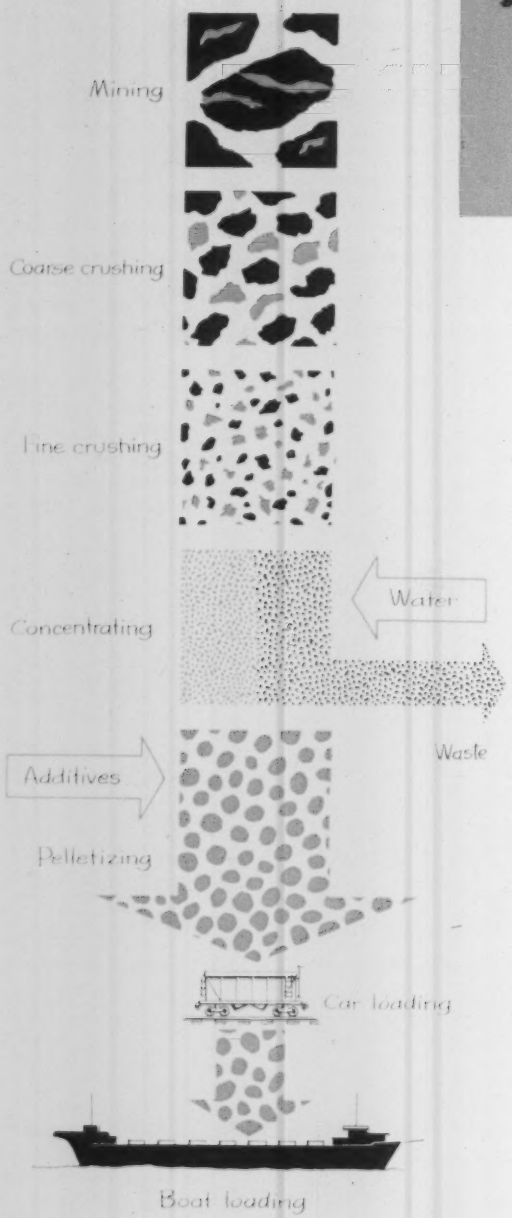
7. One very important result made our organization more competitive. Price reductions were put into effect in both 1958 and 1959—during a period of rising costs.

Our contact with the systems approach to automation, with the technics approach to material handling, and with the co-ordinated management of material handling equipment has been an exciting experience. It has been an adventure in profits.

AUTOMATION TODAY

EFFICIENT HANDLING KEY LINK IN





IT IS WELL KNOWN that the United States has consumed iron and steel products at rapidly increasing rates for many decades. One result is that the grade of remaining iron ore deposits, which can be dug out of the ground in the Lake Superior district, is lower than the deposits which were first used. In other words, the available direct shipping ores (average iron content a little over 50 per cent) of even the great Mesabi Range are of lower quality than those used first.

A solution to this problem is to develop commercially successful methods to use deposits of low grade iron ore which are still abundantly available. One of the materials fitting that description is a flint-hard rock called taconite that is found in the northern woods of Minnesota. Process developments, to take this low grade ore (iron content about 30 per cent) and concentrate the iron bearing particles into usable form, have been worked on by many individuals and organizations.

One organization devoted specifically to this problem is Erie Mining Co., formed in 1940 and now owned by Bethlehem Steel Corp., Youngstown Sheet and Tube Co., Interlake Iron Corp., and Steel Co. of Canada. Erie Mining Co. is managed by Pickands Mather & Co. Erie has made extensive studies, developed a flow sheet, and operated a pilot plant using commercial-size equipment. The result is a product that meets present blast furnace standards for grade and structure.

Their investigation showed that a commercial plant could be economically successful if it were large enough. In no other way could the cost of

TACONITE PROCESSING

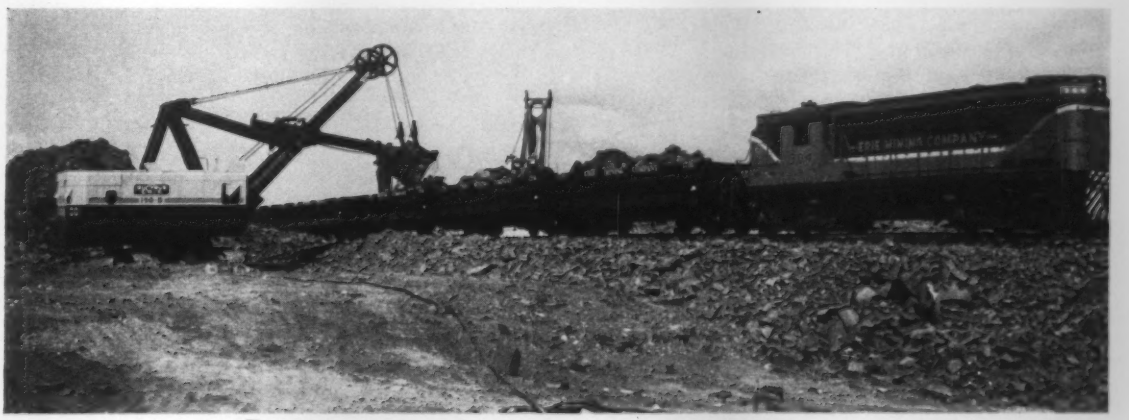
60-INCH ROCKS TO 1-INCH PELLETS

MILLIONS OF TONS

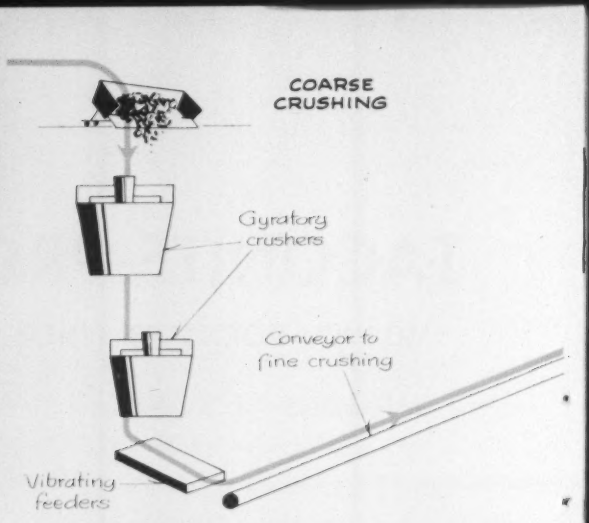
taconite be made competitive. After financing and other arrangements were worked out, Erie announced the start of an immense project in late 1953 that required more than $300 million and 4 years to build.

This project is designed to mine crude taconite at a rate of 22½ million long tons per year, process it to produce 7½ million long tons of pellets containing about 64 per cent iron, and load the pellets into ore boats on Lake Superior. In essence, the process used is to crush and grind the taconite rock to fine powder from which iron particles can be magnetically extracted. Binding materials are added, and pellets are formed and hardened by heating.

Included in this project are: The largest concentrating facility ever built as a single unit, an artificial harbor 74 miles from the concentrator, private railroad facilities, a 150,000 kw powerplant with private lines from the harbor to the concentrating site, and a townsite with more than 800 employee-owned houses. To provide the water required for process-



1 Taconite processing begins with the mining of the iron bearing rock by operations very similar to those in most open pit mines. Because of the hardness of this rock, most holes for blasting purposes are drilled by jet piercing machines which use a 4500 F kerosene-oxygen flame and water. Application of water to heated rock causes the rock to spall off in small pieces which are carried out of the hole by the steam generated. After blasting, the rock is loaded into side-dump ore cars by electric shovels. Each car carries about 40 cu yd., a weight of about 80 long tons.



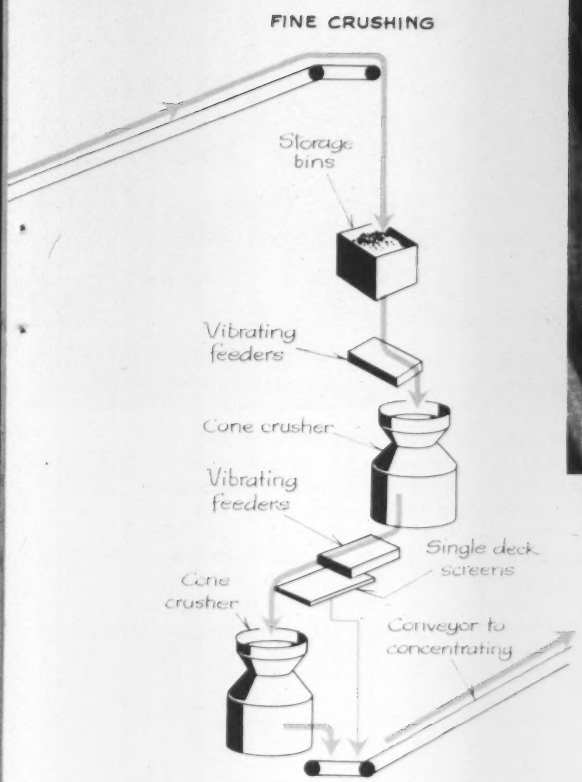
2 Taken during construction, photograph shows the processing site to which the taconite is moved by about a 2-mile ride from the mine. Elevated track brings cars to coarse crushing building, *1*. Cars are emptied and returned to mine. Taconite is crushed and carried by belt conveyors to fine crushing building, 2. After further crushing it is carried by belt conveyors to concentrating building, *3*. There it is ground to fine size in water, and iron-bearing particles are magnetically separated from tailings. The mixture of concentrate and water is pumped to the pelletizing building, *4*, where water content is reduced, additives introduced, pellets formed, and the balls hardened in furnaces. Belt conveyors then take the pellets to shipping-storing area, *5*, where they are loaded directly into cars for journey to harbor or stockpiled.

ing (annual pumping load some 42 billion gallons) a lake near the plant site was dammed so that rain and spring runoff could be retained by raising the level of the lake as much as 30 feet. Most of this water is reclaimed and re-used. Since the plant operates around-the-clock throughout the year, provision was made to stockpile about 4 million long tons of pellets with a belt conveyor stacker when winter closes the Great Lakes to navigation.

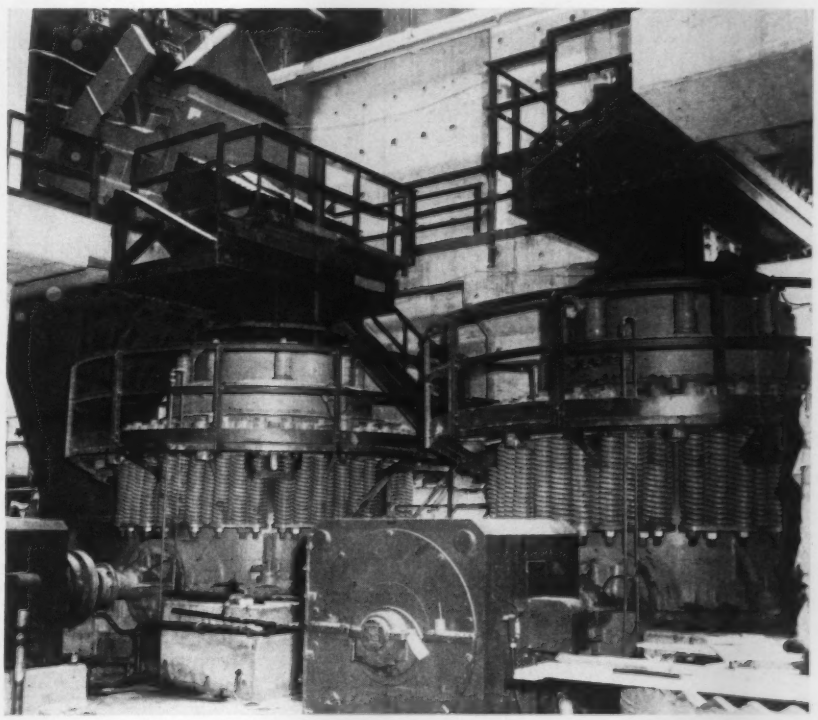
With under 3000 people for maximum capacity, it is obvious that these tremendous quantities of materials

3 In the coarse crushing building, mine cars are dumped by hydraulically actuated pistons under the control of an operator. He also controls a crane which clears the crusher if a jam occurs. Coarse crushing is a two-stage operation receiving chunks that may be as large as 5 feet in diameter. One of two 60-inch gyratory crushers performs the primary reduction to minus 7½-inch size. Input to one of these primary crushers is shown. Crusher pocket is enclosed so that dust can be carried away by fan system.

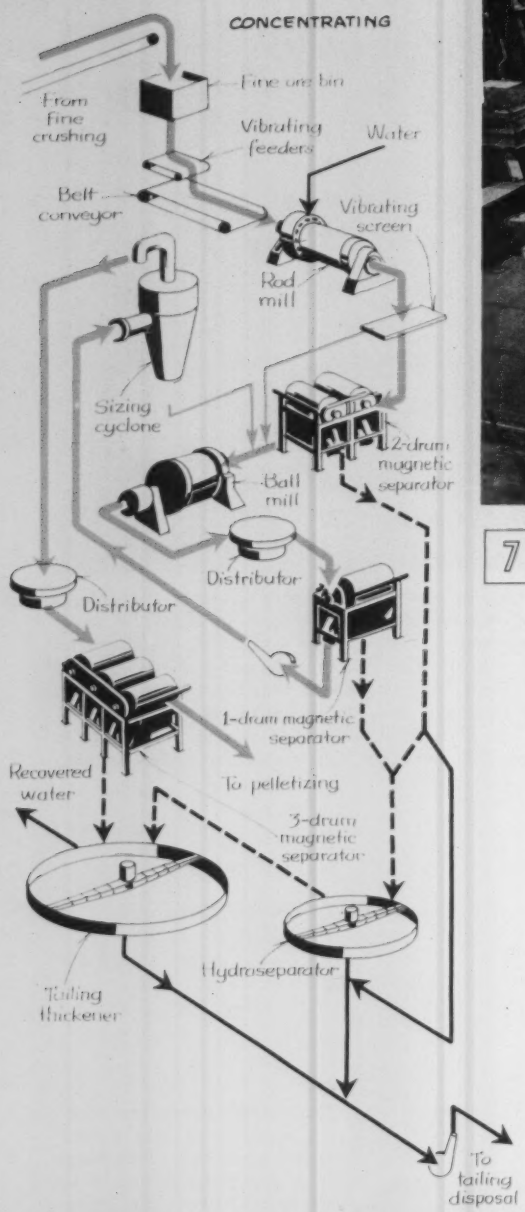
4 Photograph taken during construction shows layout of second stage crushers below primary units. Material will fall through partially completed enclosure at left to four 36-inch gyratory crushers. These units reduce the rock to minus 3-inch size. Material will form its own chute into individual units.

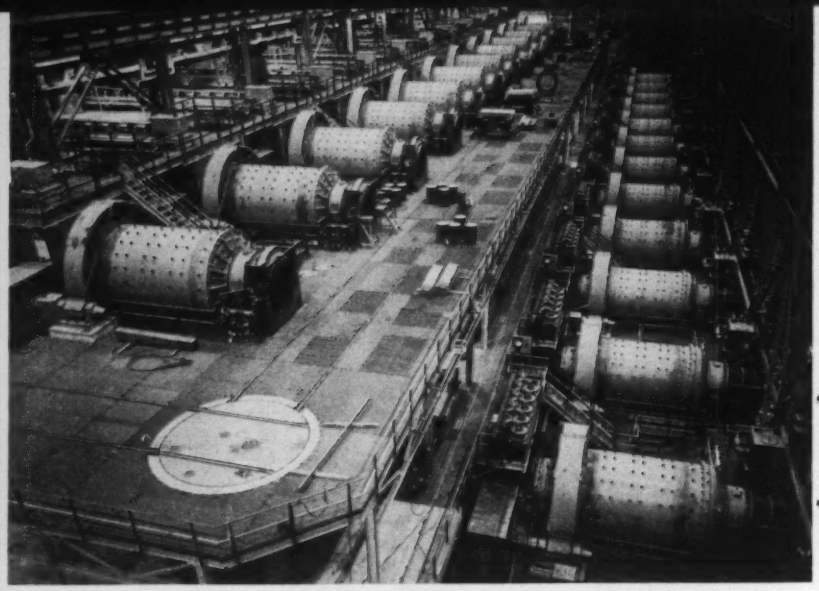


5 Also taken from above the secondary crushers, this photo shows cover plates and feeding enclosure in place. If cover plates are removed and stone flow controlled, an overhead crane can lift any of these four crushers out in its entirety for repairs. The minus 3-inch rock that falls out of these units is taken by belt conveyors to a bin in the top of the fine crushing building. To provide flexibility for adding of facilities in both buildings, the drive for this conveying system is midway between the buildings.



6 Processing in the fine crushing building is also a two-stage operation. First stage is a pass through one of six standard 7-foot cone crushers. Taconite is fed from the bin to these crushers by vibratory feeders. Flow from each of these crushers is divided between two shorthead 7-foot cone crushers beneath each standard crusher. This photo shows two of the 12 shorthead crushers in the second stage. A vibrating screen ahead of each shorthead crusher allows minus ¼-inch material to bypass that crusher. The belt conveyors to the fine ore bins in the concentrating building carry both the bypassed material and the approximately ¾-inch material from the second stage crushers.

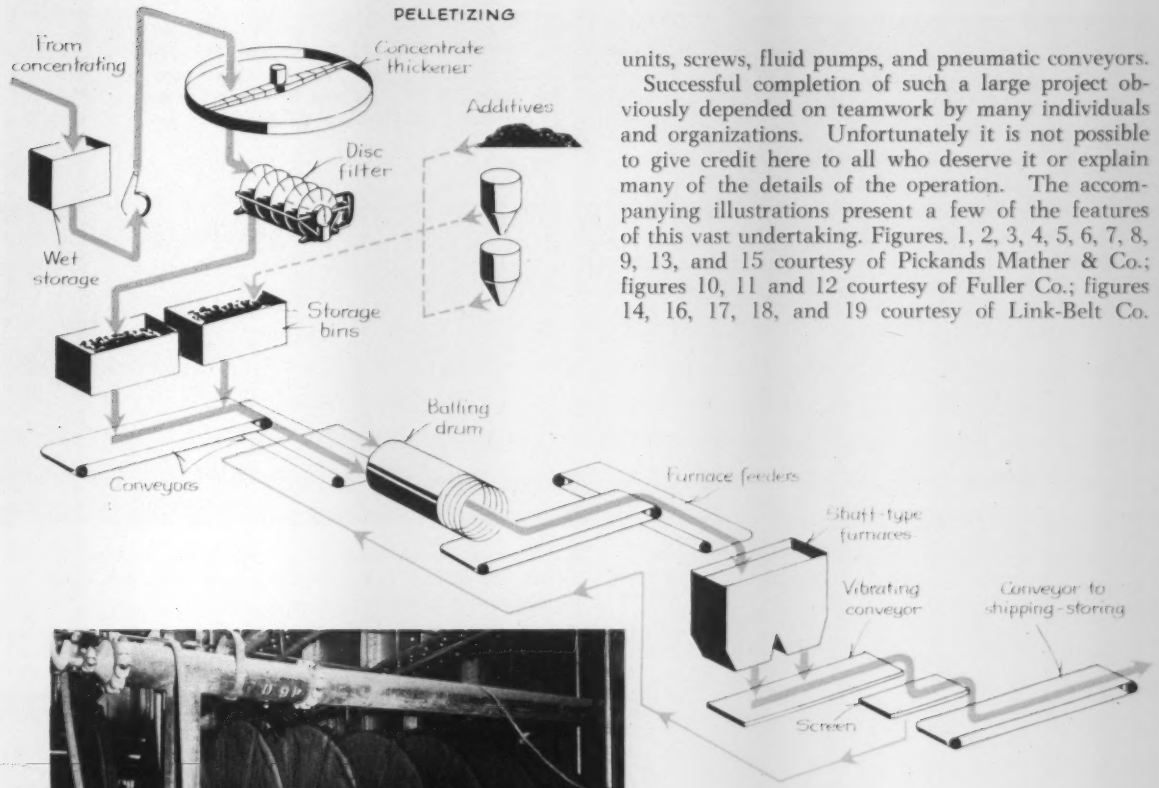




7 View in the concentrating building shows some of the rod mills on upper level at left, and some of the ball mills on lower level at right. In this building, vibrating feeders and belt conveyors feed crushed ore to 27 parallel lines that reduce ore to a size more than 50 per cent minus 325 mesh in a wet milling process and separate the concentrate from the tailings. Rod mills and ball mills are aligned on both sides of a central repair area where they can be taken by crane. Tracks by rod mills are for rod charging cars. Replacement rods, balls, and linings for crushers and mills alone are required at a rate of about 40,000 long tons per year at capacity production. Each of the 27 lines contains a rod mill, a vibrating screen, 2 two-drum magnetic separators, a ball mill, 4 single-drum magnetic separators, 5 wet cyclones for final sizing, and 4 three-drum final magnetic separators.

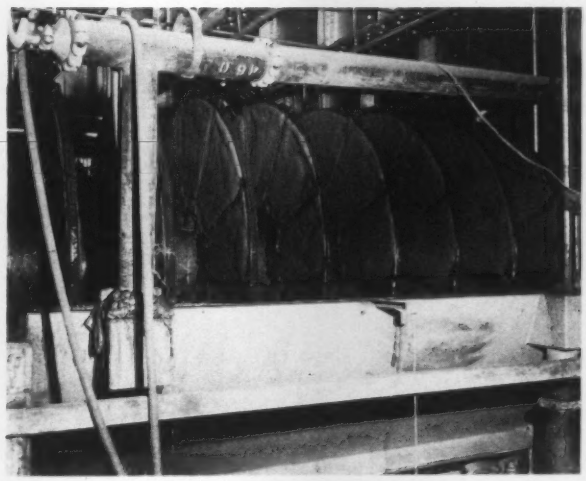
require handling facilities and processing equipment that automatically perform with a minimum of supervision. The handling arrangements associated with the various steps in the process involve most of the handling techniques found in a wide range of industries. Taconite, so to speak, goes forward by land, water, and air. Just in conveyor varieties this project applies major systems of belts, vibratory

8 Elevated units connected by catwalks are mechanical distributors that feed slurry to the magnetic separators clustered around them. Concentrate obtained is about 33 per cent of original feed by weight. About 35 per cent of feed goes to tailings from two-drum separators; about 18 per cent from single-drum units; and about 14 per cent from three-drum units. Concentrate is pumped to pelletizing building. Much of the water is extracted from slurries in 7 hydroseparators and 4 tailings thickeners (255 feet in diameter). Tailings are pumped to a tailings basin. In case of power failures, floor drains are provided to prevent flooding of the plant.



units, screws, fluid pumps, and pneumatic conveyors.

Successful completion of such a large project obviously depended on teamwork by many individuals and organizations. Unfortunately it is not possible to give credit here to all who deserve it or explain many of the details of the operation. The accompanying illustrations present a few of the features of this vast undertaking. Figures. 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, and 15 courtesy of Pickands Mather & Co.; figures 10, 11 and 12 courtesy of Fuller Co.; figures 14, 16, 17, 18, and 19 courtesy of Link-Belt Co.

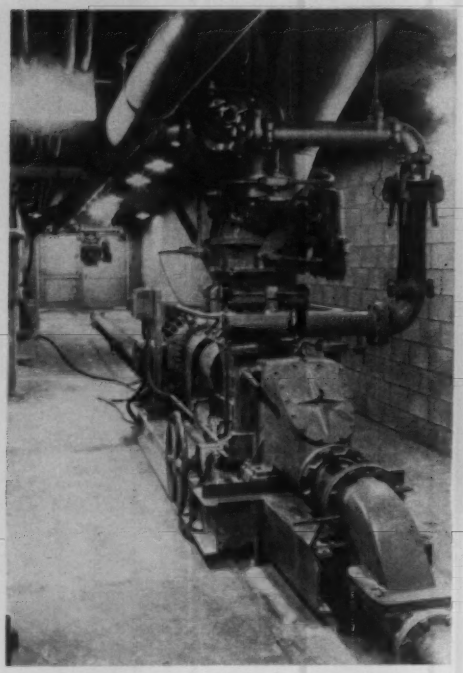


9

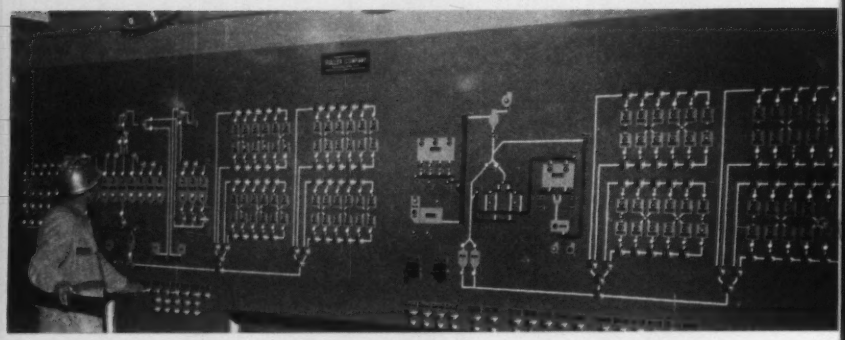
In the pelletizing plant the concentrate slurry is held in storage sumps. As required, it is pumped to thickeners and disc filters (shown) overhead in the building. Water content is reduced to about 10 per cent and the cake of iron ore concentrate is stored in bins.

10

View outside of pelletizing building shows storage facilities for materials to be mixed with the iron concentrate. Coal is stored in piles; bentonite in three large silos; and soda ash in two smaller silos.



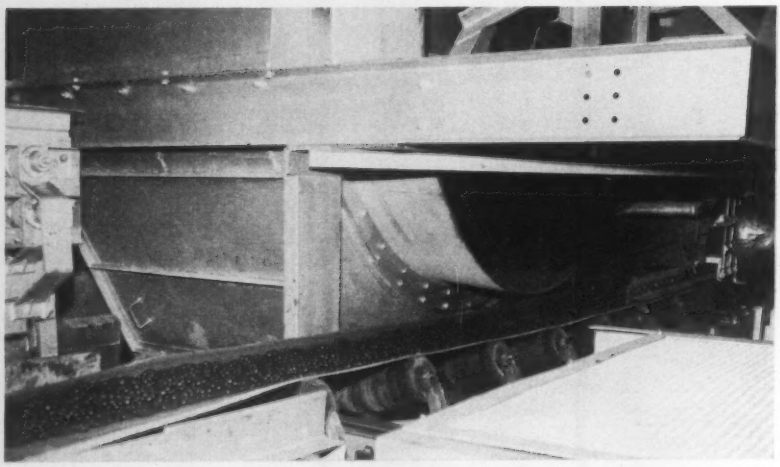
11 Pump unit shown is part of the air conveying system that moves bentonite about 450 feet from the outdoor silos to inside storage bins at a rate of 35 tons per hour. This single pump unit can be moved from the bottom of one bin to the bottom of another.



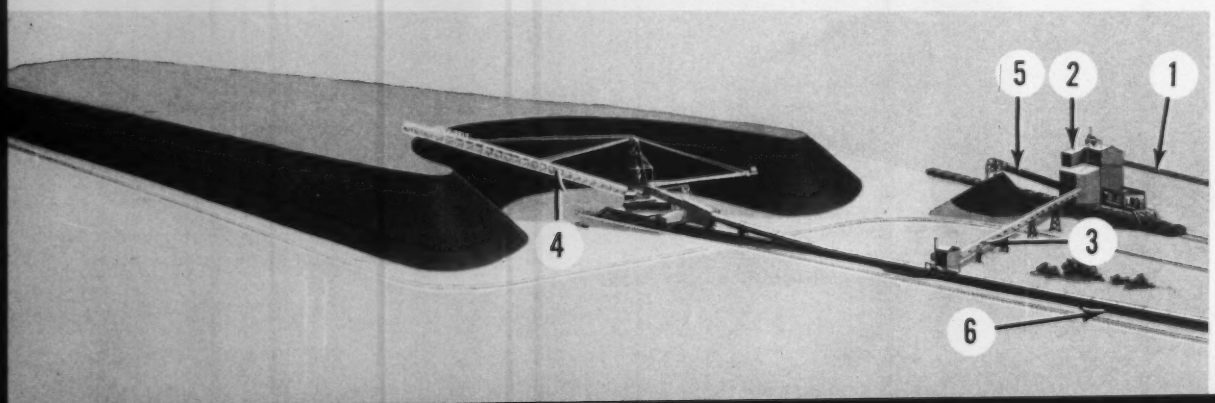
12 Centralized panel controls air conveying systems to handle powdered coal, bentonite, and soda ash used in pelletizing building.

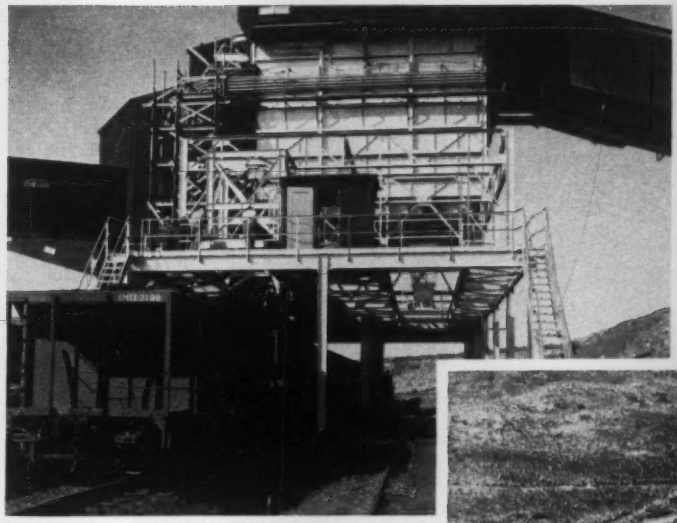
13

Additives and concentrate cake are fed in weighed quantities to balling drums. The rotation of these drums rolls the ingredients into balls about ½ to 1 inch in diameter. Balls are seen here as they roll out of a balling drum onto a belt conveyor. The belt conveyors from the balling drums feed the soft balls to wire mesh conveyors that discharge into shaft type furnaces. As balls descend through a furnace, they are heated under close control to form a hard pellet that can withstand rough handling during shipping and feeding into blast furnaces. Fuel consumption is reduced by providing for heat recuperation in the design of the 24 shaft type furnaces used here.



14 Pellets go by belt conveyor, *1*, from the pelletizing building to a bin in the car loading pocket, 2. System is designed to load pellets into dump-bottom cars at a rate of 1040 long tons per hour. If loading delays allow bin to fill, pellets can be diverted to temporary stockpile for 13,000 tons (production for about 12½ hours at capacity rate), *5*. When winter stops ore boat movements, pellets can go over conveyor, *3*, to trailing conveyor, *6*, feeding belt conveyor stacker, *4*. Stacker is the largest of its kind and can bed a pile 90 feet high, 550 feet wide at the top, and about 800 feet wide at the base. It travels over railroad tracks set on 60-foot centers. When lake shipping reopens, pellets are reclaimed from the stockpile by power shovels and loaded into cars.





15

Closeup of carloading pocket shows car being loaded with 85 long tons of pellets. Under full operation a 96-car train will move to the boat-loading facilities at the harbor every 6 hours. The private 74-mile railroad to the harbor crosses wilderness and swampland, and includes an 1858-foot tunnel through a rock hill.

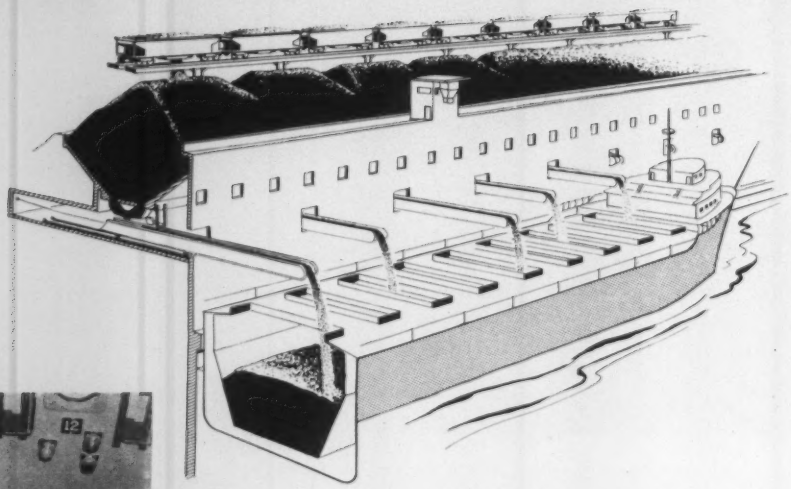
16

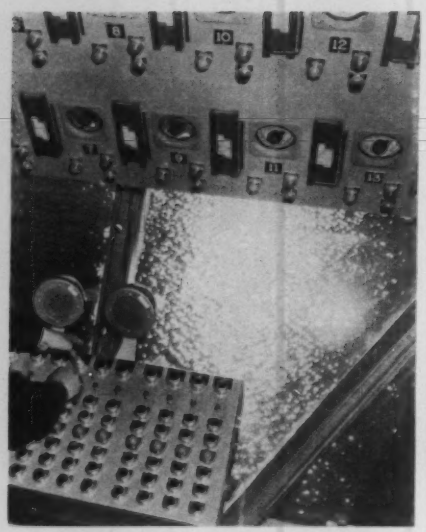
Aerial view of Taconite Harbor shows looping turnaround for trains, artificial harbor, dock facilities, the 150,000 kw powerplant, and its coal storage. Ore boats enter harbor at lower left, are loaded, and leave at upper right. The ore loading dock is 1200 feet long with provision for extension. A 510-foot coal unloading dock provides a clamshell unloader to take coal from boats.

17

Cars loaded with pellets pass over storage bins (100,000 long ton capacity) on a steel trestle and are dumped without being uncoupled. One or two boats can pull up to the dock and be speedily loaded. Pellets are drawn from the storage bins by reciprocating feeders and transferred to the ore boats by 25 belt conveyors. These conveyors are mounted on shuttles that selectively position the discharge out over the boat to a maximum distance of 50 feet from the dock face. Each shuttle boom includes a weighing unit, and each belt can deliver at two design rates, 750 or 1500 long tons per hour.

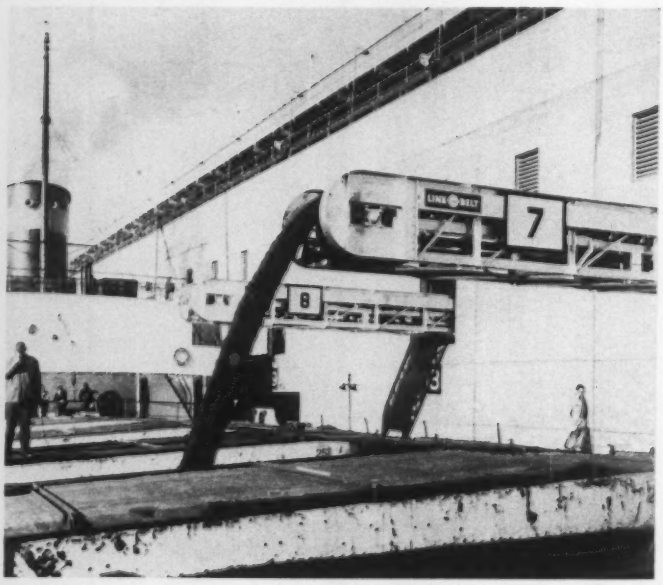
EFFICIENT HANDLING KEY LINK IN TACONITE PROCESSING





18

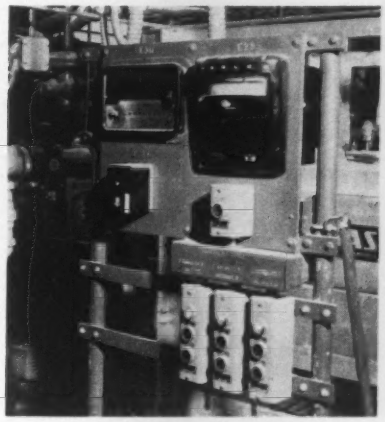
Two control rooms are built out over the water for control of the boat loading conveyors. Operator in one room controls 13 shuttles and conveyors, the other operator 12. Template cards prepared for each ore boat are attached to indicating devices (visible above operator's head) which show the relation of a conveyor discharge to the hatch opening of the particular boat. Dials indicate accumulated tonnages delivered to each hatch, and relation to preset specification for that hatch. When loading is complete, a record of weight delivered to each hatch is printed out.

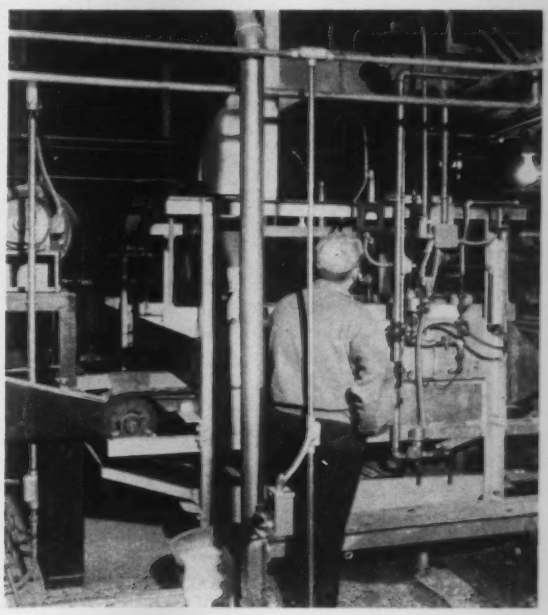


19

Communication between vessel's mate and loading operator allows final control of loading to rest with mate. The mate is responsible for distribution and final location of the cargo in the hold, and he determines where, when, and how much material will be placed in each hatch to suit varying weather conditions, ballast distribution, and similar factors. The taconite pellets then move by established routes to blast furnaces at distant steel mills.

Fig. 1—Gas-fired, radiant heating furnace placed in an asbestos shingle processing line heats shingles to a temperature of 150-160 F before they are sprayed with a solution that prevents lime efflorescence. Control panel, inset, contains temperature controller, flame-failure protective device, and blower and conveyor drive pushbuttons.





IN-LINE FURNACE PROCESSES ASBESTOS SHINGLES

SUCCESSFULLY integrating a processing unit into an existing continuous production line usually involves more than just selecting and installing a piece of equipment that can do the fundamental job. For example, the selected equipment must perform its function at pre-established line speed; its size and floor space requirements must be compatible with the layout; and its input and output sections must be capable of receiving and discharging product smoothly to and from the line. Frequently, the controls for the new equipment must be responsive to changing line conditions as well as equipment functional requirements.

All of these considerations affected the design of a preheating furnace, *Fig.* 1, installed in an asbestos shingle processing line at the Manville, N. J., plant of Johns-Manville Co. The furnace was added to the existing processing line to permit adoption of a recently developed surface treatment technique that prevents lime efflorescence during and after the manufacture of shingles. Before the asbestos shingles can be sprayed with a special preventive solution, their surfaces must be heated to approximately 150-160 F.

The furnace, designed and built by Selas Corp. of America, consists basically of an endless wire belt and a gas-fired radiant heating unit. The belt receives products from the line, passes them horizontally under the heating unit, and discharges them for further processing.

Several product sizes, colors, and formulations are processed by the line. Because these variables result in different heat absorption rates, both the belt

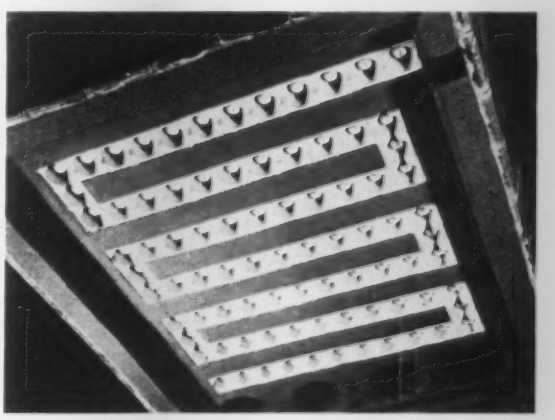


Fig. 2—Roof of furnace contains 84 gas burners set in ceramic wells. Surfaces of cup-shaped wells become incandescent when heated and develop radiant heat that is directed downward to product. Because of complete combustion of gas-air mixture within the wells, flames do not impinge on the product.

speed and the heat input of the furnace must be adjustable. A variable pitch sheave in the belt drive takes care of belt speed changes, and a proportioning type temperature controller built by Wheelco Instruments Div., Barber-Colman Co., provides temperature control.

Temperatures are sensed by a thermocouple placed in the roof of the furnace where it is acted on by a stream of hot gases that flow from a series of Duradiant gas burners to a flue connection at one end of the furnace roof. The proportioning type controller receives temperature information from the thermocouple and automatically adjusts the fuel supply to the burners to maintain a preset temperature at the point of measurement. In normal operation, this temperature is set between 1400 and 1600 F.

The radiant heat developed by the Duradiant burners, *Fig.* 2, results from burning closely controlled gas-air mixtures against special cup-shaped refractory surfaces. These ceramic surfaces, which become incandescent, develop and beam radiant heat to the shingles. Because combustion is completed entirely within the cups, the burners have no harmful flame impingement and shingles can pass extremely close to the heat source without damage. The burners can be advanced or retracted with respect to the work by means of handwheels on the four corners of the furnace roof.

By beaming the heat directly at the shingles, heat dissipation is greatly reduced and high heating rates are possible. Despite the relatively open design of the furnace and the fact that operating temperatures as high as 1600 F are attained in the furnace chamber, an operator may work within 8 to 10 inches of the furnace without discomfort.

A Wheelco Flame-otrol mounted on a panel adjacent to the furnace provides flame-failure protection. In the event of flame failure, the fuel to the burners is automatically shut off by this device. It also provides automatic ignition when the unit is restarted.

To prevent the development of hot spots on the belt, a cold water spray unit located under the furnace provides automatic cooling during furnace operation. A pan under the sprayer collects the water. In addition, a timing device is used on the belt drive to keep the belt in motion for 30 minutes after burner shutdown. Circulating the belt for this period prevents overheating of any particular section due to continuous exposure to the residual heat in the 4-foot long hot chamber.

CORRECTION

IN the article entitled "Handling Equipment Improves Automatic Honing Operation," which appeared in the March 1959 issue, a typographical error appeared in the second sentence of the second paragraph on page 63. This should read: "The sleeves are honed at the rate of 144 parts an hour at 80 per cent efficiency; geometric accuracies of better than 0.0005 inch for roundness and taper, and bore sizes consistently within 0.0007 inch tolerance, are obtained."

STORAGE BANK UPS MACHINE UTILIZATION

ESTABLISHMENT of storage banks between machining operations is a commonly used technique employed in the metalworking industry to integrate various machines having different cycling rates into a continuous production line. This same technique has been applied in the woodworking industry to solve a similar problem. A typical example can be found at Pascagoula Veneer Co. where large logs are skived into wood veneer sheets for processing into plywood.

Wood veneer is produced on large lathes which hold and revolve a log between two chucks while a knife is slowly advanced to cut a continuous sheet of material having uniform thickness. At first contact, the lathe knife cuts only the high spots on the revolving log and produces a shower of scrap debris called rossings. As the blade cuts deeper into the log, the rossings gradually increase in size until some are large enough to yield usable pieces of veneer called broken sheets or fishtails. When the knife has reduced the log to a cylindrical shape, continuous unbroken sheets of veneer are produced from the remainder of the log. All usable sheets of veneer, including the broken sheets, are then processed through a clipper which trims them into proper sizes for use in plywood.

A common practice in the industry is to install the clipper adjacent to the lathe and to feed the material by conveyor directly from the cutting lathe to the clipper. However, this type of installation results in inefficiencies since either the lathe or the clipper must stand idle for periods of time while the other completes accumulated work. Large diameter logs producing long, unbroken sheets require intermittent operation of the lathe while the clipper works full-time. Conversely, small diameter logs, requiring frequent log changes and producing a large number of broken sheets, keep the lathe busy and the clipper idle.

Solution to the problem was to spread the two machines apart and to install a storage bank system between them. This arrangement was developed

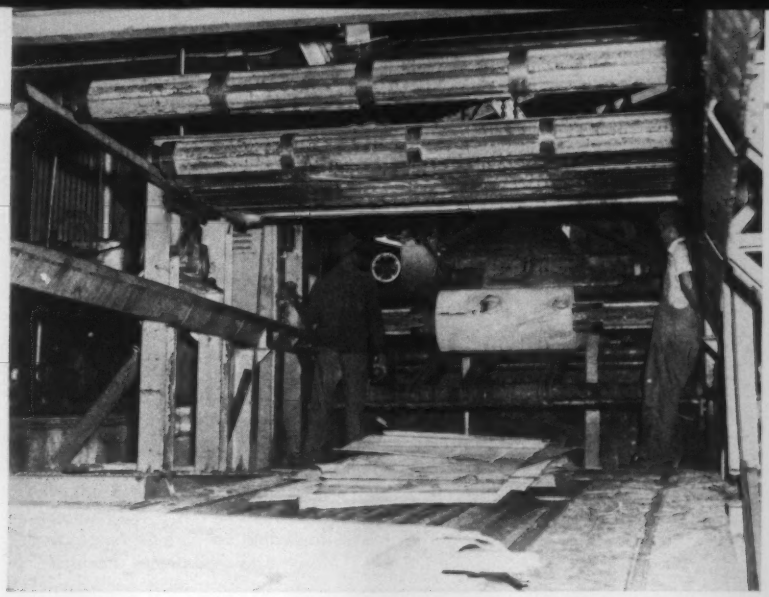


Fig. 1—View of the output side of the veneer cutting lathe shows the operation of the winding device for unbroken sheets of material. Operators are standing on the lower deck which is used to accumulate broken sheets. Full coils of veneer are transported to the clipper over the lower pair of tracks which are approximately waist-high to the operators. Empty arbors return from the clipper on the upper tracks over the heads of the operators.

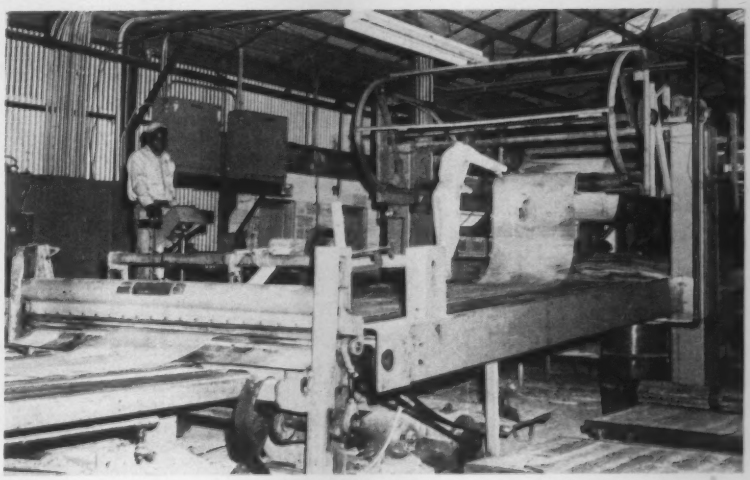


Fig. 2—The clipper is installed in line with the lathe unit. Full coils of veneer are loaded into the unreeling unit from the lower tracks of the lathe unit at the right. Empty arbors are swung overhead along the semicircular track to the upper tracks leading back to the lathe. Broken sheets are trimmed to length on an auxiliary clipper located between the two machines, immediately below the unreeling unit. The veneer, unwinding from arbor, is carried by conveyor belts to automatic clipper at left where it is trimmed to uniform lengths.

by the builders of the lathe and the clipper, Merritt-Solem Div., Solem Machine Co., and is shown in *Fig.* 1 and 2.

When a new log is being skived on the lathe, the rossings produced drop into a trench for removal by a waste conveyor. The rossings gradually increase in size until usable fishtails are being cut. These broken sheets are accumulated on a lower deck of the storage system, *Fig.* 1, and are later moved to an auxiliary clipper for trimming to size. When an unbroken sheet of veneer starts coming from the log, the lathe is stopped, and an arbor is loaded into winding position. The sheet of veneer is attached to the arbor, and the lathe is started again. Now, the lathe feeds skived material directly onto the arbor which winds the veneer into a coil. A pneumatically operated clutch mechanism couples the arbor to an electric variable-torque drive to maintain a constant tension on the veneer as it is wound. When the arbor has been filled, the coil of veneer is transferred to the main clipper by means of a lower track. Depending upon the work load at the clipper, the coil may be used immediately, or it may be temporarily stored on the track.

One coil after another is loaded into an unreeling unit and fed at a suitable speed to the main clipper, *Fig.* 2. The drive for the unreeling unit is operated in conjunction with limit switches located in a conveyor-type table. These switches start and stop the drive unit so that a free loop of veneer is maintained between the arbor and the table. Conveyor belts in the table then carry the veneer sheet to the clipper for cutting into uniform sheet lengths. Another conveyor system on the output side of the clipper removes the cut sheets to storage. After an arbor is emptied, a pair of arms push the arbor upward over a semicircular track until it rides onto an upper track leading back to the lathe unit.

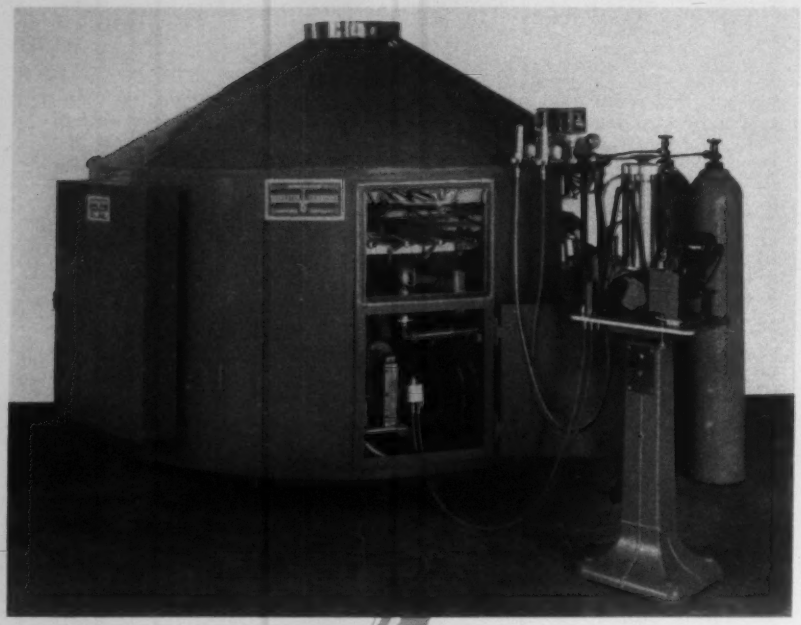
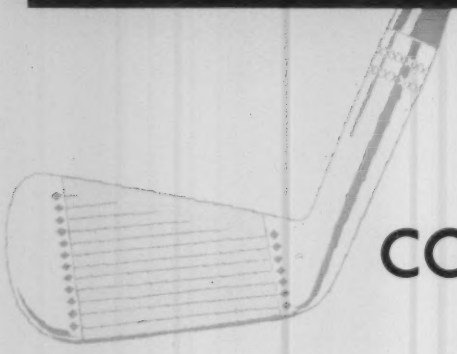


Fig. 1—Machine to apply ceramic coatings to golf club heads is shown prior to installation. Powder for coating is fed from pedestal unit (shown with cover removed), through oxygen hose, to oxyhydrogen torch. Automatic, co-ordinated movements of torch and workpieces produce coatings consisting of many individual layers of material.



OLD GAME–NEW DEVELOPMENT

COATING GOLF CLUBS WITH CERAMICS

ON AUTOMATIC MACHINE

HOW TO protect golf club faces against wear and corrosion? How to help a golfer frame a ball on the club face? These were needs that led the MacGregor Co. to consider application of ceramic coatings to their club heads. But such a coating would be impractical if it could not be efficiently applied on a production scale. MacGregor found that Armour Research Foundation had developed a process to apply such coatings; and, through the joint efforts of Continental Coatings Corp. and Sylvester & Co., an automatically cycled machine was developed to process club heads on a production basis.

In the machine, *Fig.* 1, powdered titanium dioxide is fed from a pedestal unit, through an oxygen line, to an oxyhydrogen torch. The torch applies the coating to club heads as they pass over it. A screw feeder regulates flow of the powder into the oxygen stream, and orifices and expansion chambers smooth out any feeding pulsations. Club heads to be coated are manually loaded on circular rails around the periphery of a turntable which is 6½ feet in diameter. The turntable holds 96 heads, arranged so that the toes of alternate heads point toward the center of the table and the others point outward.

The rails not only hold the heads but also mask the portions of the faces that are not to be coated. Each head is located on the rails by hardened points that mate with a standard pattern which is part of the design on the faces of all the heads to be coated. The toe of each club is held down by a small permanent magnet which also holds the head firmly in position on the locating points. Since the turntable is connected to its power drive through an over-running clutch, the operator can easily push the table ahead as he loads and unloads it.

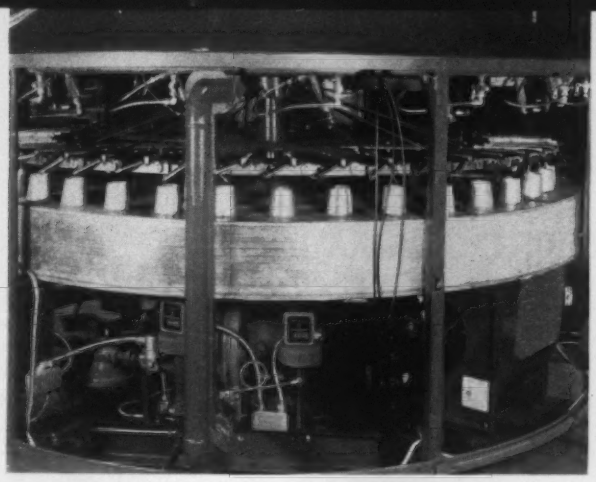


Fig. 2—View with machine housing removed shows major components of machine. Electrically ignited preheating torches are arranged above the club heads on the turntable. Cooling air from plenum chamber under turntable is directed up through conical nozzles and around club heads while the oxyhydrogen torch applies coatings.

When the machine is ready to be cycled, the push of a button starts the rotation of the turntable and starts an air blower to supply combustion air for gas burners that preheat the club heads, *Fig.* 2. Buildup of pressure in the blower outlet pipe triggers a timer. A natural gas valve is opened, spark plugs in electric igniting circuits light preheat burners, and the heads pass under the natural gas flames. Heads are preheated for 2 minutes until the timer closes the gas valve and de-energizes the spark plugs.

As the first timer times out, it starts a second timer. A fan is started that blows cooling air up past the heads, oxygen is allowed to flow to the oxyhydrogen torch, a valve is opened sending natural gas to a pilot for the torch, and the pilot is lit by an electric ignition system. The gas pilot is turned off between cycles so that there will be no danger of sooty deposits on the faces to be coated. The electric ignition system is not used directly for the torch flame since the spark electrodes would rapidly disintegrate in that flame.

After 5 seconds the hydrogen valve is opened, and the torch flame is established. Following another 5-second delay, the feeding of powder into the torch is begun. As the turntable carries the workpieces past the torch, the molten coating material is deposited on the club heads. While the turntable rotates, another drive system moves the torch across the club faces toward the center of the turntable. About 32 passes of the torch are made across each clubface during this inward motion. An equal number of passes are made as the torch returns outward. A total of 64 layers of coating material, each about $\frac{3}{8}$ inch wide, are thus deposited on each club face. Time required to deposit the coating is about 9.3 minutes.

When the torch returns to its starting position, it actuates a limit switch; the torch drive is stopped; and the powder feeder is stopped. After 5 seconds the hydrogen valve is closed; then after another 5-second delay the oxygen valve is closed; and the pilot gas and igniter are turned off. Finally the blowers are turned off, the turntable stopped, and the machine is ready for unloading.

Safety features are incorporated into the machine. It will come to a stop in case of power failure, or severe pressure drops on natural gas, oxygen, or hydrogen. The preheat control timer will not operate unless the blower builds up sufficient pressure in the burner air line. Nor will that timer run unless there is sufficient pressure in the natural gas line. The turntable must be rotating before the preheat burners can be ignited. If the oxygen or hydrogen pressures are not up to required levels, the torch control timer will not operate. These interlocks prevent explosions that might result if, for instance, one gas backed up into a second line due to pressure failure in the second line.

THE FLAME CERAMICS PROCESS

FLAME CERAMICS is a process that sprays a ceramic material at more than 4000 F onto the surface of a base material. This process does not require that the base material be heated to a high temperature to receive the ceramic coating. Refractory and chemically inert materials such as aluminum oxide, zirconium oxide, or oxides of rare earth metals are fed in powdered form through a simple flame gun.

A wide variety of physical, chemical, and electrical properties can be obtained by using various mixtures of powdered metals, cermets, glass frits, or other materials. Properties obtainable include: Good abrasion and wear resistance; high dielectric strength; mechanical toughness; chemical inertness; high surface melting points; sealing for corrosion protection of base material; thermal insulation.

Thickness of coatings can be increased indefinitely by repeated applications, but for most applications a thickness of 0.010 inch seems adequate.

Some of the many potential uses anticipated by the developers include: To insulate electrical components for operation at high temperatures; to coat molds to allow precision casting with better metals; to increase life of forging tools and dies; to permit use of less critical metals and less expensive refractories where resistance to heat and oxidation are prime considerations; to protect engine parts; to resist abrasive wear in pumps and valves.

The process was developed and patented by Armour Research Foundation of Illinois Institute of Technology, and world rights on the process are held by Continental Coatings Corp.

TAPE CONTROLLED TURRET LATHE FEATURES SIMPLIFIED PROGRAMMING

SIMPLICITY of programming, compactness in installation, and low initial cost characterize a tape control system developed by Potter & Johnston Co. as optional equipment for its line of automatic turret lathes. Tape controlled automatics have been in use for some time at the plant of an aircraft manufacturer who estimates that increases in efficiency made possible by the control system will result in a 25 per cent saving in setup and machining time over the course of a year.

All motions of the spindle, turret, and cross slides of the automatic turret lathe, *Fig.* 1, and all speed and feed changes are programmed on an easily prepared punched tape. Placing the tape in the machine's tape reader requires only a couple of minutes and eliminates costly setup time. Since no tubes or transistors are used in the control system, the unit lends itself to servicing by regular plant electrical maintenance men.

For average machining jobs, the tape for the system can be prepared in 30 minutes or less by clerical or nontechnical employees. The clerk first fills in a program chart using a simple code sheet and an operation sheet of the type commonly employed for jobs done on automatic turret lathes. Following the coded program chart, the clerk then punches the required tape using a unit which is equipped with turret position and address point dials and machine function pushbuttons, *Fig.* 2. The technique of tape preparation can be taught to the average nontechnical employee in less than one hour.

The tape control units do not require any additional floor space since they are installed as an integral part of the lathe itself. In addition to being supplied as optional equipment on new machines, the tape control system can be installed on any current Potter & Johnston precision automatic already in the field. This retrofit requires only 2 to 3 days. One tape preparation unit is capable of servicing all tape controlled automatics in a plant, even though several different sizes of machines are involved.

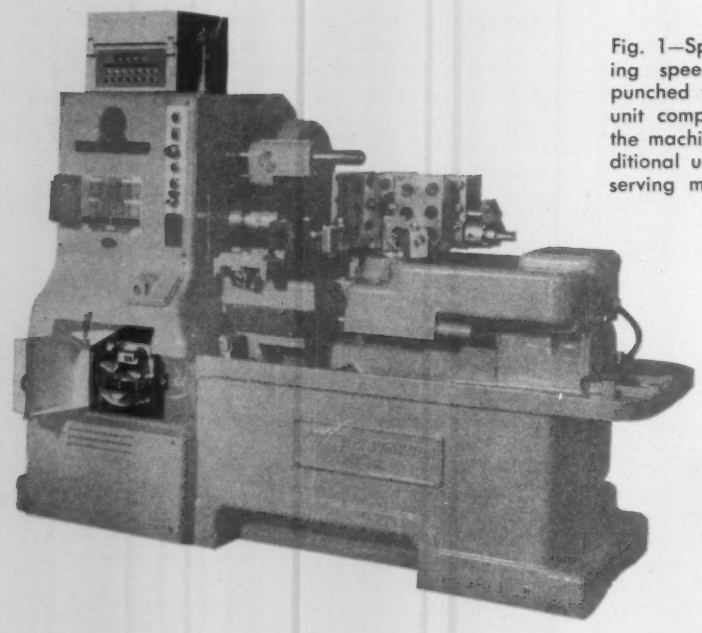


Fig. 1—Spindle, turret, and cross slide motions, including speed and feed changes, are controlled by punched tape on this automatic turret lathe. Control unit components include the relay box on the top of the machine and the tape reader in the base. No additional units are required to operate the system, conserving manufacturing floor space.

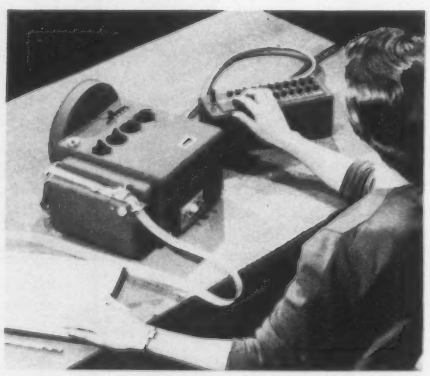


Fig. 2—Tape preparation for the turret lathe is relatively simple. Turret position is set by the hexagonal dial, and the remaining three dials select the address points to advance the tape. The pushbutton unit at the right is used to punch the desired machine function code into the tape. The average job can be programmed in 30 minutes or less by a nontechnical employee.

CASTING STEEL IN RE-USABLE MOLDS

PROMOTED BY AUTOMATIC POURING

By **GILBERT C. CLOSE**, Hawthorne, Calif.

PRODUCTION casting of steel wheels for railroad cars to a dimensional tolerance on the order of one tenth of one per cent is achieved by Griffin Wheel Co. at its Colton, Calif., plant. Such precision on 700-pound castings is obtained by using permanent molds made of graphite rather than rammed sand molds. The car wheels cast in these molds are so accurate that no machining is required except in the hub bore; and they are expected to have many times the life of conventional wheels produced in rammed sand molds.

Though molds made of graphite have several advantages, they also have major disadvantages for production use. Their advantages include high rate

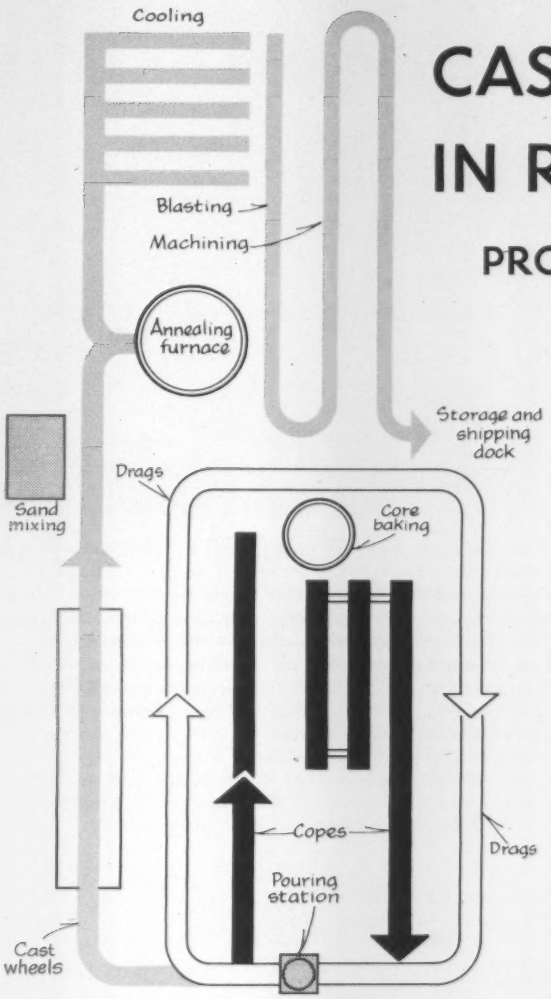


Fig. 1—Diagram indicates process layout in plant devoted entirely to the production of steel railroad car wheel castings. Two electric furnaces melt the metal required for production of 480 wheels per day. Furnace charge is largely old car wheels with additions of commercial scrap to adjust composition of the melt to specifications. Hot metal is discharged from the furnaces into large ladles to be used at the casting station. Handling of molds and wheels is performed by an integrated system of equipment.

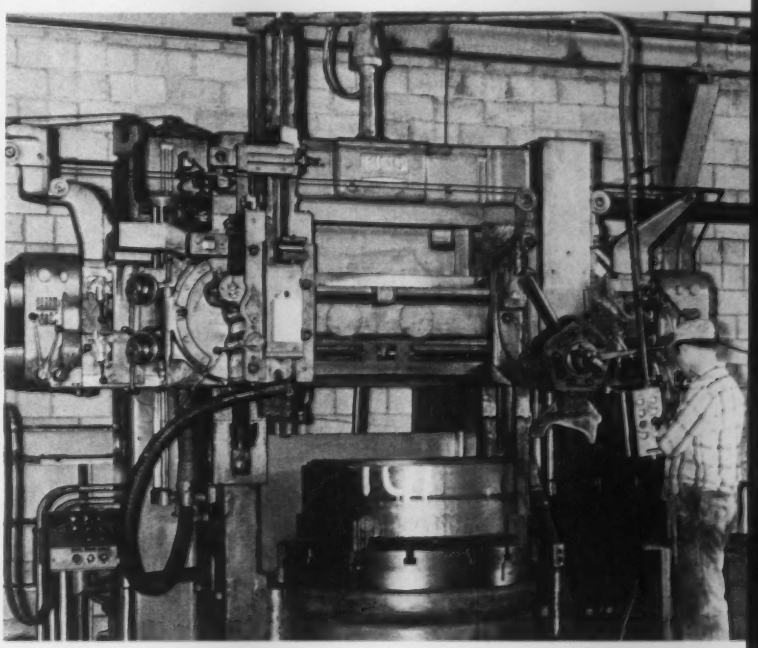


Fig. 2—Modified King boring mill is used to form mold cavities in graphite mold halves. Each half of the mold is 42 inches in diameter and 18 inches thick. The cavity is first roughed out by a tracer-controlled tool, then finished with a one-piece tool which is contour-ground using a template. Each mold can be used for an average of 1000 castings before it must be discarded, but after each use it is inspected and refaced in the boring mill if required.

of heat conduction, low coefficient of expansion, good resistance to thermal shock, and good machining characteristics for generation of mold cavities. But graphite molds will not withstand mechanical shocks and are rather easily eroded by flowing metal. To obtain the advantages and minimize these disadvantages, the graphite molds at Colton are protected by metal flasks, moved by mechanical handling equipment, and "poured" by a special casting process that forces molten steel up into the mold from below with the rate of flow carefully controlled. Casting of wheels in the graphite molds is economically possible because of the integrated line of equipment, mostly special, that has been installed in the Griffin plant.

The accompanying illustrations present a tour through this plant which was designed, built, and tooled to facilitate use of the automated graphite mold casting process. It is considerably different from a conventional foundry where several types of castings are produced.

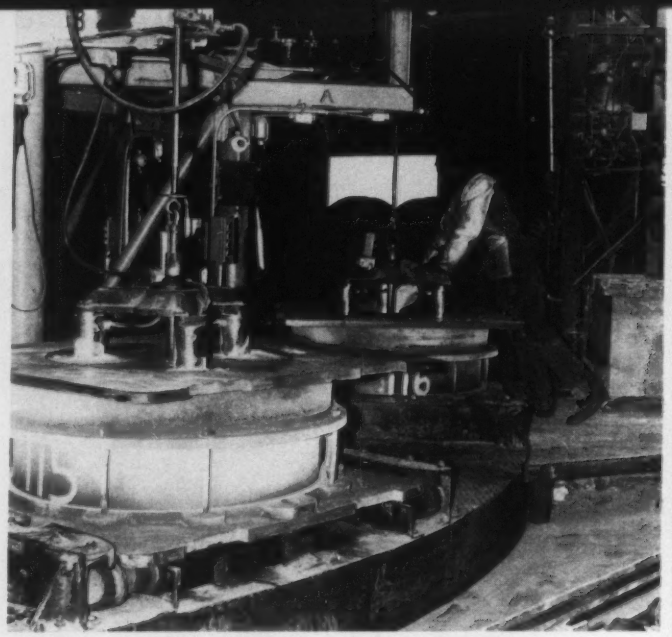


Fig. 3—Cope half of each graphite mold provides four risers to return metal to the casting during solidification. Baked sand sleeves made from a shell molding mixture are used to insulate the riser metal from the mold and prevent erosion of the mold around the risers. In this rotary baking machine, sand mixture is poured around electric heating elements which act as patterns and bake the sleeves in place. These sleeves must be replaced each time the mold is used. A plunger with a graphite plug on its lower end, inserted through the riser in the center of the mold, is used to hold molten metal in the mold.

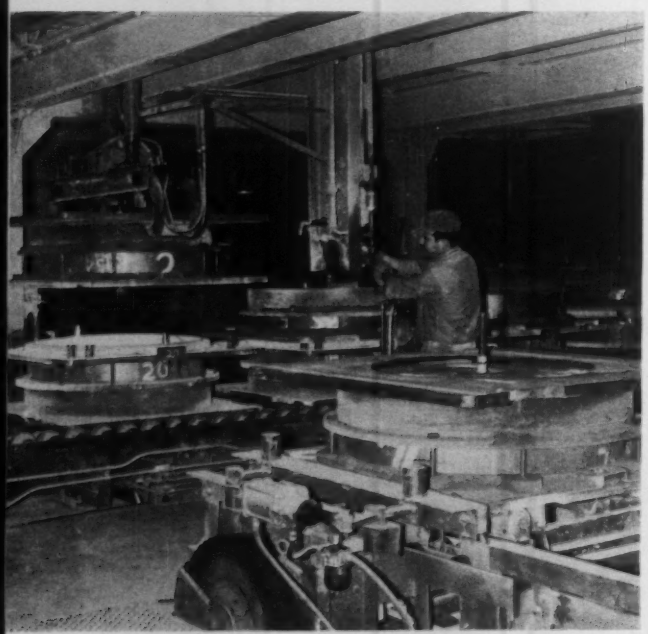


Fig. 4—New molds and used molds that have been reconditioned are sprayed with a parting solution; then the cope section is lowered into place on the drag section at this station. The completed mold is then moved to the casting station.

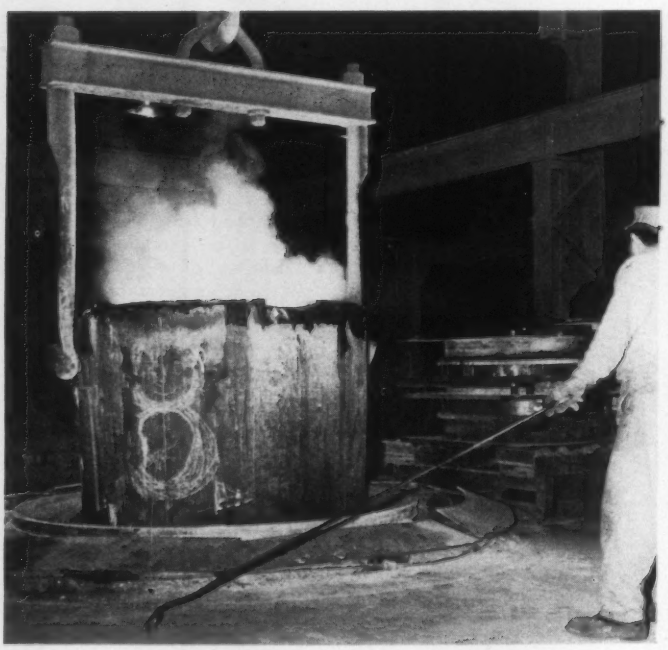


Fig. 5—A ladle containing approximately 20,000 pounds of hot metal is lowered into a reinforced concrete pit at the casting station.

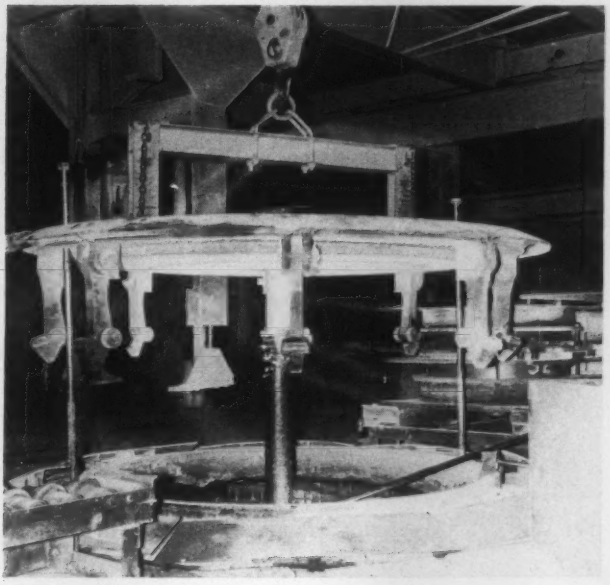


Fig. 6—After the ladle is in the casting pit, the pit cover with its built-in refractory pouring tube is placed over the pit and sealed in place with pneumatic clamps. With the cover in place, the pouring tube is immersed in molten metal to within about 3 inches from the bottom of the ladle. The completed mold is placed directly over the opening in the refractory pouring tube. The molten steel is thus in an air-tight chamber whose only outlet is up through the refractory tube leading to the mold.

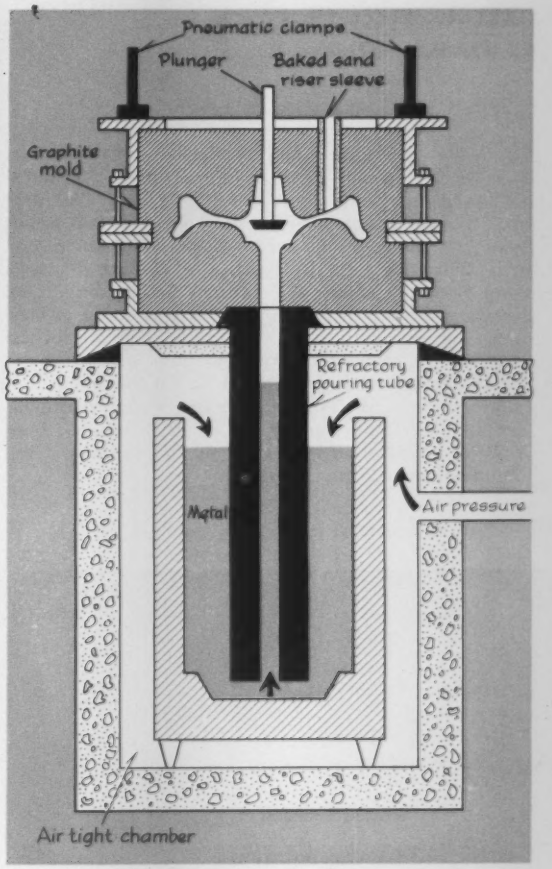


Fig. 7—Cross section of casting pit shows mold clamped in place. The operator directs dry, compressed air into the casting pit. As pressure builds up on the surface of the metal in the ladle, it forces the metal up through the refractory pouring tube. The rate of flow is automatically controlled by regulating the flow of compressed air into the pit. Initial flow rate is about 60 pounds per second. This is reduced as the mold becomes filled. Too fast a flow would erode the mold; too slow a flow would cause cold-shuts, scabs, and wrinkles in the casting itself. Records of each cast are made automatically.

Fig. 8—By observing the flames from the risers, the operator determines when the mold is full and stops the casting process. The plunger with its graphite plug is then automatically shoved downward by a pneumatic piston until the pouring gate of the mold is plugged. Air pressure can then be reduced in the casting pit but metal for the wheel will be trapped in the mold. Time required to cast a wheel is 20 seconds. Total time to remove a filled mold, replace it with an empty, and complete the casting operation can be about 1¼ minutes.

CASTING STEEL IN RE-USABLE MOLDS

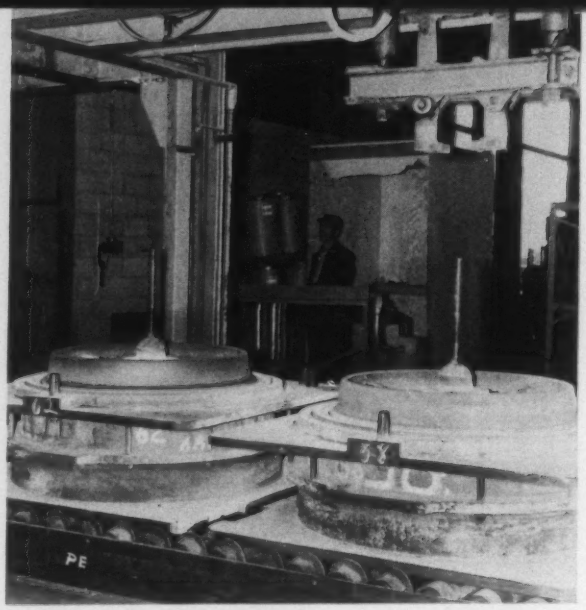


Fig. 9—Due to the high heat conductivity of the graphite mold, the wheel metal solidifies within 5 minutes, but the metal in the risers is still soft after this interval. By appropriate timing, the mold is parted under these conditions by a remotely-controlled lifting device. Since the metal in the risers is still soft it breaks away from the wheel and remains in the cope. On the wheel this leaves only a stub which is easily washed away with a cutting torch. The plunger handle of the plug used to stopper the pouring gate is used at the station shown in this photograph to lift the wheel and transfer it to a conveyor that passes through a cooling tunnel. The temperature of the wheels is reduced from 2000 to 1000 F at a rate slow enough to prevent the formation of cooling stresses.

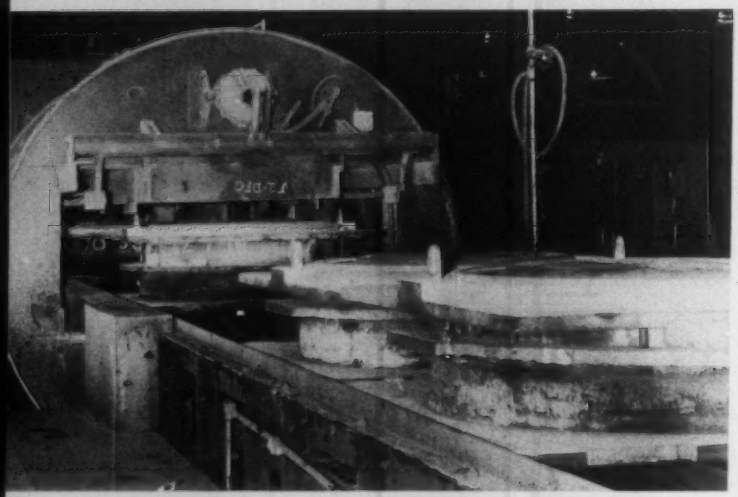


Fig. 10—After the casting is removed from the drag half of the mold, the drag is moved into a positioning device that tips it to a vertical position for cleaning and inspection of the mold. Cope half of the mold is similarly inspected and cleaned, including removal of the used riser sleeves. New sleeves are baked in place and the mold halves are then sprayed and closed for the next casting cycle.

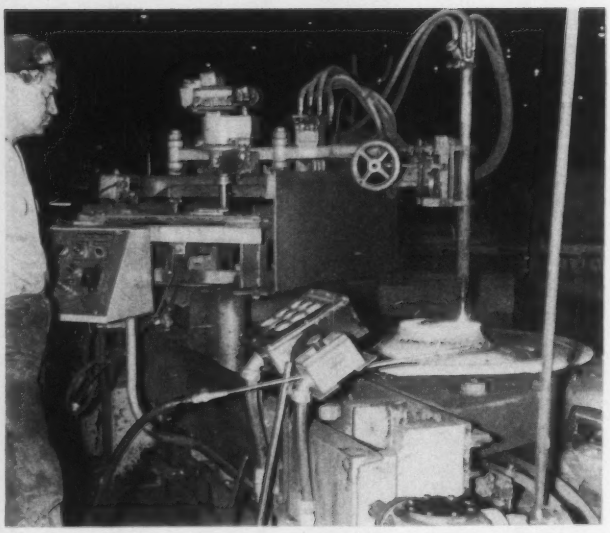


Fig. 11—After cooling, the wheels pass through a cleaning area where the riser stubs are washed off with a torch; the wheel is rolled over; and the graphite stopper plug is chipped out. A second torch-cutting operation, shown in photo, then rough-cuts the hub bore. Here again the remains of the plunger handle prove useful. The hollow center of the tube provides a convenient starting point for the cutting operation which requires about two minutes. The torch is automatically guided by a template and accuracy is sufficient to keep machining to a minimum.

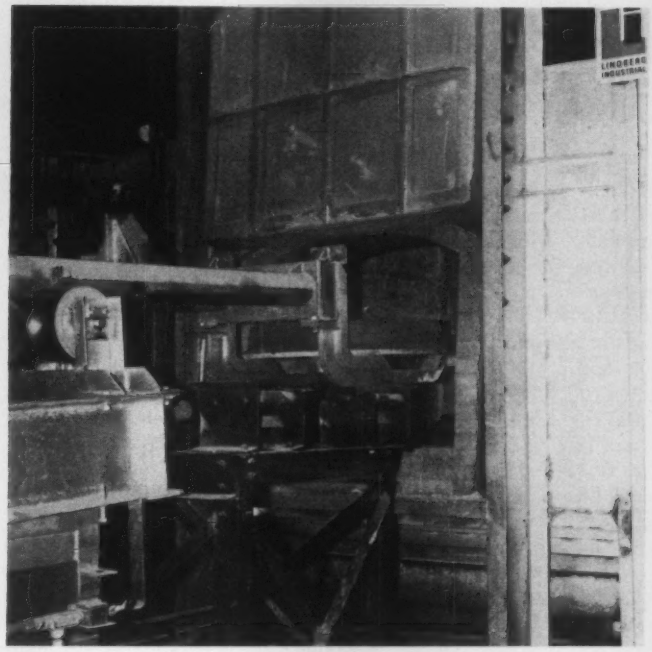


Fig. 12—Annealing of the wheels is accomplished in one of the few relatively standard major pieces of equipment in the plant. This is a rotary-type, gas-fired Lindberg furnace 45 feet in diameter. The furnace provides four heat zones from 1600 to 1700 F, holding time per wheel of 1½ hours, and capacity of 480 wheels per day. A Griffin-designed unit loads and unloads wheels without stopping of the rotary furnace conveyor. When an annealed wheel is in position at the access door, the door is automatically opened; lifting forks move in under the wheel and remove it from the furnace. A similar handling device places an unannealed wheel in the furnace. After being annealed, the wheels are stacked three high on a roller conveyor which carries them under a canopy outside the building for final cooling.

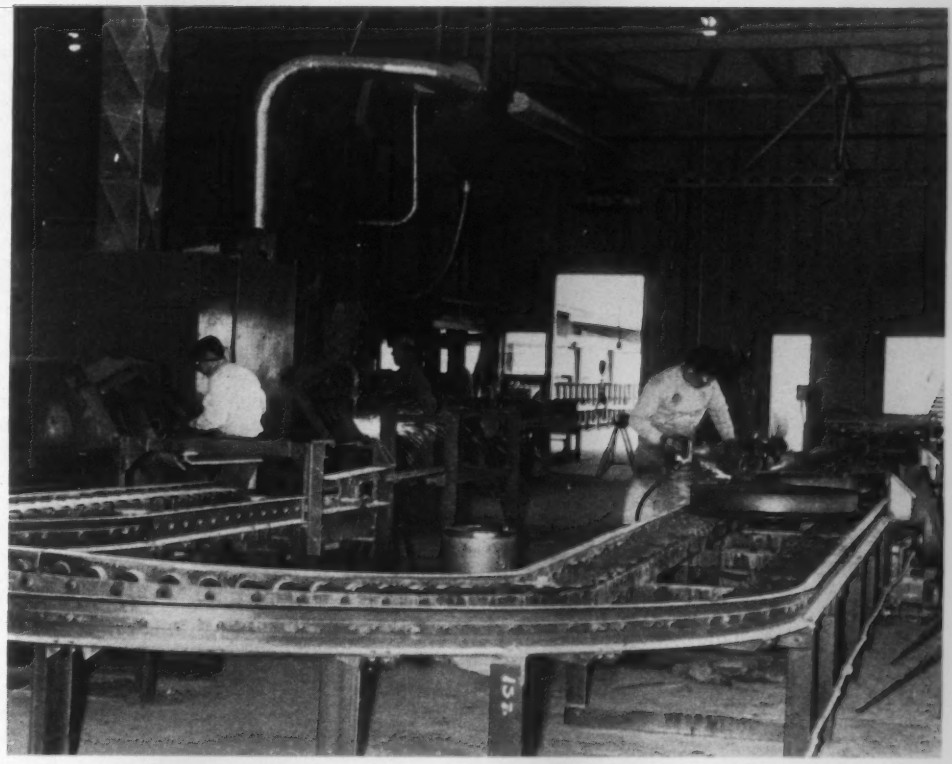


Fig. 13—Cooled wheels enter this finishing area. Airless grit blasting in a Wheelabrator cleaning unit is used to prepare wheels before Magna-Glo inspection for surface defects. This is followed by visual inspection; then the hub is bored on an automatically-fed Kearney & Trecker boring machine. After the hubs are bored, the wheels are weighed to check for internal cavities and are then ready for the shipping department.

THERMISTOR ALARM SYSTEM PROTECTS WAX CIRCULATING LINES

STORAGE of raw materials in outdoor facilities is a practice that many companies must employ to conserve valuable indoor manufacturing space. Under such conditions, the stored materials are usually of types that are relatively unaffected by temporary exposure to adverse weather conditions. However, this is not the case at Nashua Corp., manufacturers of wax coated papers for food products. Their problem consists of storing liquefied paraffin waxes (solidify at about 145 F and 165 F) in four large outdoor tanks, *Fig.* 1, and preventing the wax from congealing in supply lines leading into the plant. If the wax congeals, it forms a solid plug in the lines and could shut down the production line for 3 to 5 days while the lines are being cleaned out.

To help avoid wax plug-ups in supply lines, Nashua has installed a four-point thermistor alarm system, developed by Fenwal Inc., to monitor the wax temperature at the base of each outdoor storage tank. Since it would have been impractical to install thermistor temperature probes through the tank walls without draining the tanks, the probes were simply lowered into the wax down through the tops of the tanks. Each probe is supported on a length of chain which reaches to within a few feet of the tank bottom where the temperature is most critical and where the probe will always be immersed.

Leads from the four thermistor probes are wired to a compact control panel, *Fig.* 2, in a pump house adjacent to the tanks. In case the wax in any tank falls below a preset temperature (155 F for paraffin in three tanks and 175 F for special wax in the fourth tank), the controller triggers an alarm in a nearby boiler house to alert maintenance personnel. The alarm temperature is set about 10 degrees above the actual solidification point of the wax to provide ample time to locate the difficulty and remedy the trouble.

Several considerations led to the selection of a thermistor-type alarm system. Since the controller does not use a standard cell or require a reference junction temperature, it is unaffected by ambient conditions in the pump house where the air temperature may vary from 100 to 140 F, depending on the season. The thermistor elements themselves, which employ temperature-sensitive semiconductor materials, do not age appreciably. This makes them highly stable in continuous service. Finally, the probe leads can be ordinary electrical conductor (Nashua uses bell wire) without affecting sensing accuracy and without risk of induced electrical interference from nearby power lines.

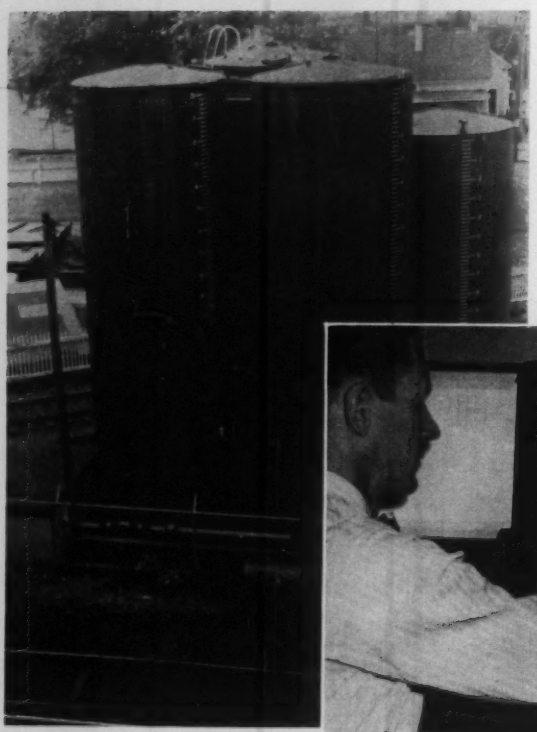


Fig. 1—Four outdoor wax storage tanks at Nashua Corp. hold liquefied paraffin wax for use in the manufacture of wax coated paper. Wax is maintained fluid at all times by a continuous recirculation system. Wax is drawn from the base of each tank, passed through a heat exchanger to maintain the temperature within a range of 3 degrees, and returned to the tank through a vertical riser extending up through the center of the tank. Danger of a complete freeze-up in a tank is remote unless the recirculation system is out of service for several weeks in the winter.

Fig. 2 — Four-station thermistor controller maintains a continuous check on wax temperature in all four tanks. Developed by Fenwal Inc., the controller contains one plug-in control unit for each point to be monitored. Desired control or alarm action can be set independently for each point. When the temperature in any tank drops below the set point, the controller actuates an alarm. A selector switch enables maintenance personnel to check temperature of all four tanks to locate the trouble point.

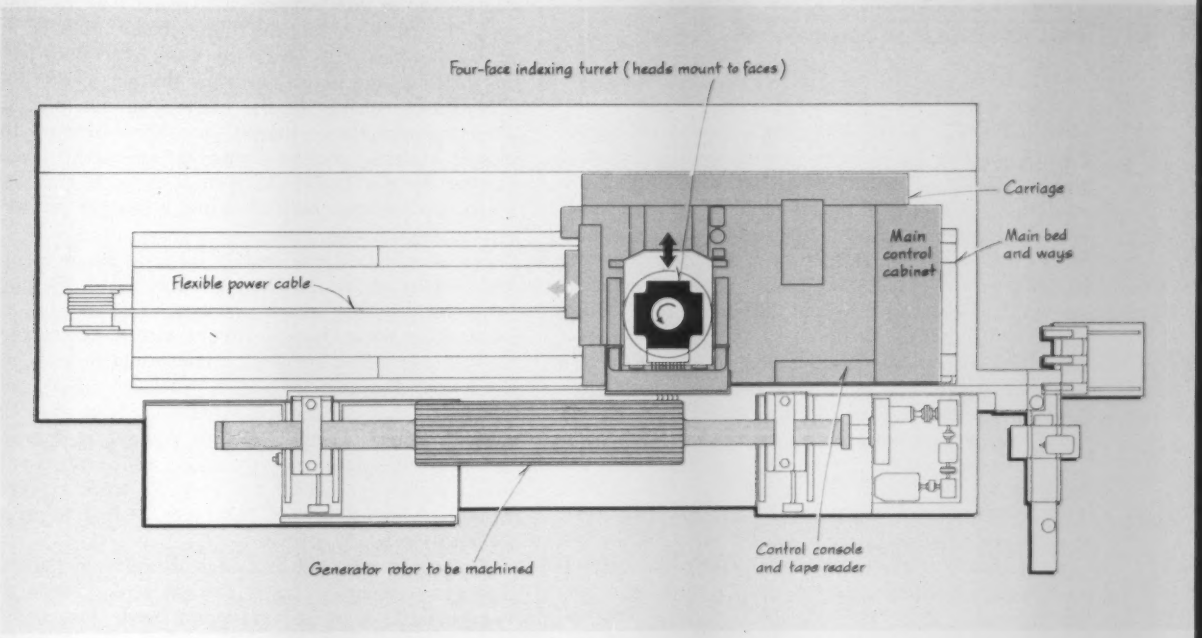

Four-face indexing turret (heads mount to faces)
Carriage
Main control cabinet
Main bed and ways
Flexible power cable
Generator rotor to be machined
Control console and tape reader

Fig. 1—Plan view illustrates major elements of numerically controlled machine for drilling, reaming, tapping, and spot milling large generator rotors. Longitudinal positioning of carriage on ways and the feed and indexing motions of multihead turret are to be controlled by punched tape. Auxiliary functions such as machining sequence and notification of tool change times will also be programmed on tape.

TAPE PROGRAMMED MULTISPINDLE MACHINE

SIMPLIFIES ROTOR PRODUCTION

By L. G. KROPACEK, A. MARTINSON, and T. L. HALLENBECK

Large Steam-Turbine Dept.
General Electric Co.
Schenectady, N. Y.

Baker Bros. Inc.
Toledo, Ohio

ADVANTAGES of numerically controlled machine tools are being exploited increasingly in a variety of industries. Systems in use number in the hundreds, and new installations are being made regularly. An application of numerical control to a machine for drilling, tapping, and spot milling generator rotors, in progress at the Large Steam Turbine-Generator Dept., General Electric Co., Schenectady, N. Y., is a case in point.

All motions, speeds, and feeds of the machine, built by Baker Bros. Inc., Toledo, Ohio, will be controlled by punched tape. Instructions for the machining sequence, notification of tool change times, and shutdown of the machine until tools have been changed are also to be programmed by tape.

▶ Machine Features

The machine, *Fig.* 1, includes a movable carriage that can be positioned longitudinally on ways. Slides on the carriage support and permit lateral motion

of a four-faced index turret. Each face of the turret, *Fig.* 2, can be fitted with one of several types of heads. Heads for drilling, tapping, and milling are available. The heads for drilling have five horizontal spindles each. Five models are available with different center-to-center spacings of the spindles. Each spindle is capable of receiving drills up to 1¾ inches in diameter; holes up to 12 inches deep can be drilled. When a single hole is required, only the center spindle is fitted with a drill. In addition, the turret may be equipped with a single-spindle tapping head so that drilled holes may be tapped when required. By mounting a vertical slide on a turret face, a five-spindle milling head can be used for tangential milling of air entrance slots, *Fig.* 3. The cutters themselves are mounted horizontally for this operation.

Changeover of the multispindle heads is simplified, and housekeeping improved, by a unique pumping arrangement. With the machine operating, the oil used to lubricate the head drains to a sump in the turret base and is then pumped automatically to a reservoir in the top of the turret.

Heads that use tools requiring support are equipped with bushing plates. Rods on which the bushing plates are fastened enter holes in a master bushing bracket located between the turret and the work, *Fig.* 4. When a head is used for radial ("on center") drilling, holes in a fixed position on the master bracket are used. For machining at points above or below the centerline of the work, adjustable blocks in the bracket receive the bushing plate rods. For drilling angular holes, heads may be set up so that the tools enter the work anywhere from 6½ to 14 inches above or below the part centerline.

Hydraulic springs in the turret keep the bushing plate support rods plugged into the holes in the master bushing bracket during an operation. Force exerted by the hydraulic springs is such that the bushing plates can back off when a buildup of chips occurs around the tools.

Five nozzles on the master bushing bracket convey coolant at low pressure to each of the bushings for a head in the work position. The nozzles are adjusted to wash chips down the face of the bracket into a chip conveyor that removes chips from the machine. In addition, high pressure (300 psi) coolant is fed to oil tube drills used in the "on center" heads. Feeding of this coolant is through the bushing plate support rods, and occurs only when an "on center" head is in its work position. This arrangement avoids the need for high pressure rotating joints.

Coolant is collected in a central tank and pumped through a separator to a storage tank. From the storage tank, a centrifugal pump feeds the coolant via reel hose to the movable carriage. At this point the coolant flow divides to go to the low pressure wash supply and to the inlet of a high pressure pump that supplies the "on center" oil tube drills.

Gearing in the turret makes available up to 30 horsepower to drive the spindles of a head when it is indexed into working position. Spindle speeds are variable and set by tape command. The dc motor and a motor-generator set are located on the carriage. Also mounted on the carriage are a main control cabinet, the operator control station, and a

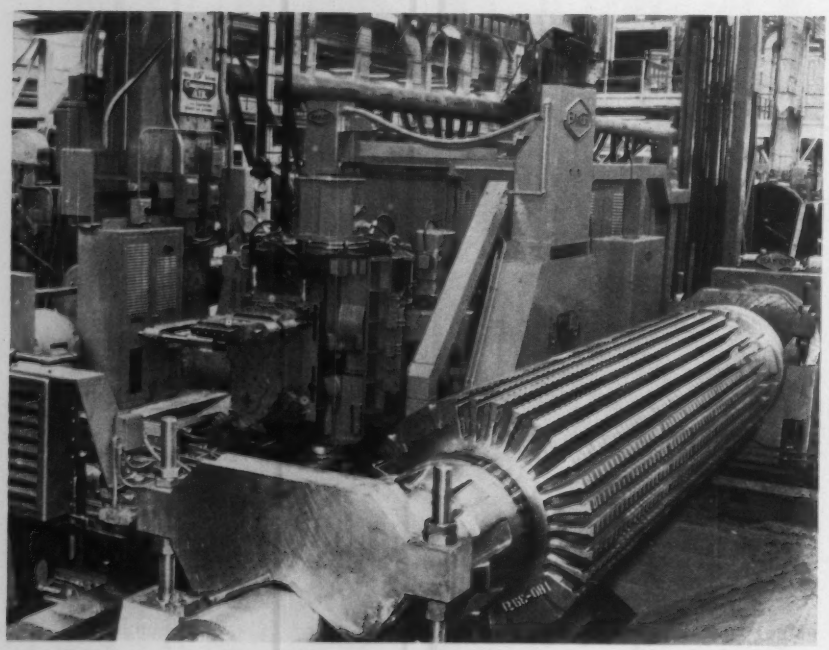


Fig. 2—View of machine carriage illustrates multihead turret, center, in position to perform tangential milling operation on rotor in pedestal mounts. Longitudinal slots in rotor were produced in a previous operation. Tall structure between turret and workpiece supports a master bushing bracket that confines tool guide bushings relative to the work.

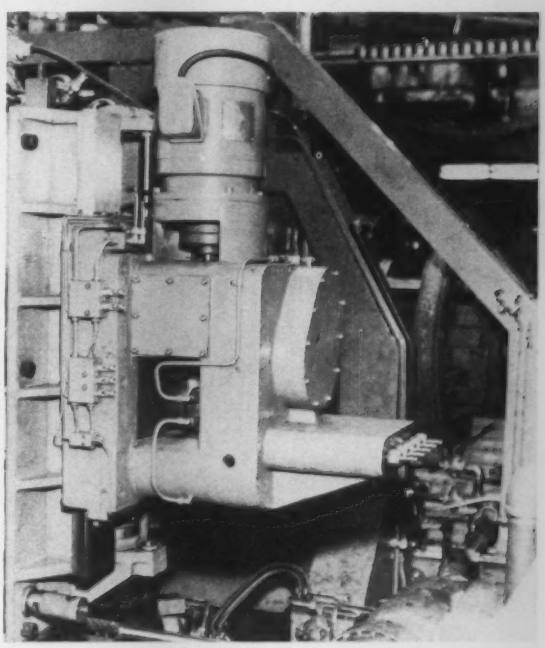


Fig. 3—Five-spindle milling head is one of several types of heads that can be mounted on faces of index turret. After it is indexed into position and advanced over the work, milling head operates vertically on slides to perform tangential milling operation that produces air entrance slots in rotors.

tape reader. Power is supplied to the carriage units by counterweighted cables.

The drive for the carriage is by means of a dc motor and gear reducer that rotate a pinion. The pinion engages a rack along the bed of the machine to move the carriage. The slide carrying the turret is powered hydraulically through cylinders on each side of the slide. Vertical motion of the five-spindle head for tangential milling is effected by a motor and screw arrangement which are integral with the head.

Power for the motors for the tapping and tangential milling operations is applied through a slip ring assembly. This assembly also furnishes a means of indicating which face of the turret is in the working position.

Rotors to be machined are placed on pedestal mounts that contain bronze half-shell bearings. The pedestals can be moved laterally with respect to the machine bed to accommodate rotors from 30 to 64 inches in diameter. One of the pedestal mounts can be moved longitudinally to adapt to different length rotors. The largest rotor weighs 180,000 pounds.

A powered turning device is coupled to one end of each rotor placed in the pedestal mounts. This rotating mechanism is capable of turning a rotor at a coarse rate of 2 rpm. It also has a creeping mode which starts at 1/12 and decreases to 1/1200 of the coarse positioning rate. Final angular positioning of a rotor is obtained by means of gage blocks inserted in longitudinal rotor slots produced in a previous operation. The gage blocks work in conjunction with an indicator limit switch post which bears a predetermined dimensional relationship to the machine.

▶ Position Control

A G. E. numerical positioning control is used to position both the carriage and the turret for a work cycle. The system employs selsyn transducers that provide feedback signals indicative of actual positions of the machine members. These signals are compared with reference signals representing desired positions. The reference signals are generated in response to commands from the tape reader. When the actual position of a member being controlled differs from the position called for by the tape, a difference, or error signal will result from the comparison. Control actions will then cause motion of the member in a direction to reduce the magnitude of the error. When the error signal has been reduced to zero by motion of the member, positioning is completed.

To position the carriage, the error signal is amplified and used to excite the field windings of an amplidyne motor-generator set. The latter device is used as a power amplifier to energize a dc carriage drive motor. The carriage has a travel of 24 feet. Traverse is at 290 ipm and positioning is at 36 ipm. Positioning accuracy is 0.0005 inch.

Some rotors require the drilling of as many as 2700 ventilating holes 3 inches deep. Multiple holes for these rotors are drilled in lines based on uniform longitudinal spacing. However, since these operations are tape controlled, the drilling cycle can be programmed so that spacings are skipped at predetermined places on the rotor. Individual holes can be interspersed with the multiple holes by tape command. These can be placed at any point longitudinally on the rotor.

To move the turret, an error signal is applied to control valves that operate hydraulic cylinders associated with the turret slide. Intermediate positions less than full stroke can be selected in increments of 0.1 inch. However, positive mechanical stops are used to determine final depth and rear limit positions of the turret.

Two types of turret feed cycles are used in drilling. One consists of rapid advance to the work, feed to depth, and rapid return to neutral. Arrival of the drills at the feed point commanded by the tape is signaled by a selsyn pickup. The other type of feed cycle involves rapid advance to the work, feed less than full depth, retract, rapid advance to bottom of partially drilled hole, feed to second depth, etc. This cycle, involving the drilling of holes to final depth in increments, is useful for deep hole drilling. This cycle is also programmed on the tape and checked by selsyn pickup.

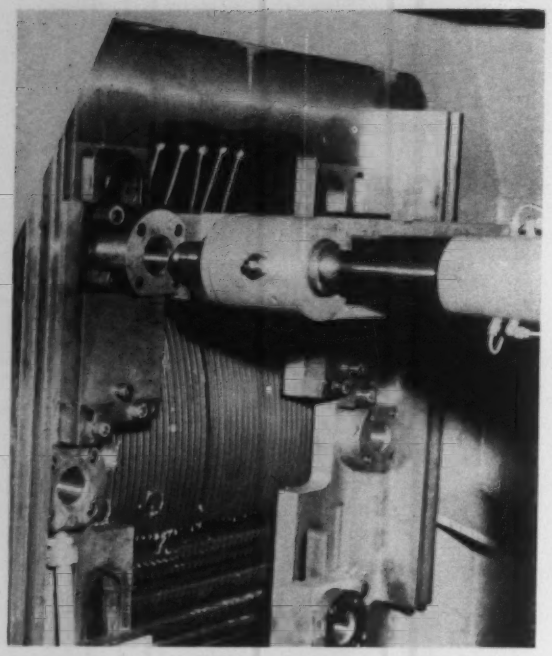


Fig. 4—Turret heads that use tools requiring guide bushings are equipped with bushing plates. Rods on which bushing plates are fastened enter holes in a master bushing bracket when the head is advanced toward the work. Two pairs of blocks with holes are adjustable above and below the work centerline. Rods are shown entering holes in upper pair of blocks. Fixed pair of blocks contains holes located on part centerline to guide the bushing plates for "on center" operations.

Tape Preparation

A Flexowriter typewriter operator will prepare the tape, using a tape manuscript provided by a planner. Standard 8-channel tape will be used, with information coded in simple alphanumeric form. For example, code letters *J, K, L, M, N, P, Q,* and *R* will designate command functions, while numerical information will indicate distances, face of turret, or particular tool desired. Thus:

J followed by 000.000 denotes the carriage longitudinal position.

N followed by 00.00 gives turret slide lateral position.

M followed by 1, 2, 3, or 4 designates the turret face to be indexed into the working position.

K followed by five numbers taken from the series 1,2,3,4,5,6,7,8,9, and 0 turns spindle identification lights on or off to indicate tools required. Odd numbers are light *On* commands, while even numbers call for light *Off* conditions. For example, a *K*23570 command for a five-spindle head indicates on a light panel that the next setup requires tools in the three center spindles with none in the outside spindles. When the *K* command is read, an operator changes the tools in the spindles. The tools are obtained from a rack at the rear of the machine. Electrical interlocks prevent operation of the machine until the tools have been selected from the rack. The *K* function may be used to program setup changes (different drill sizes, insertion of reamers following drilling, etc.) or replacement of tools about to become unserviceable because of dulling.

L followed by any or all of the numbers 2,4,6,8, or 0 stops the machine and calls for a tool replacement.

P calls for a milling cycle after an *R* setup call.

Q designates a tapping cycle. A typical tape command for tapping might be *M4Q*, in which *M4* directs the number 4 face of the turret (containing the tapping head) into the working position, and *Q* initiates the tapping cycle.

One operator will be assigned to the machine. He will be required to set up the workpiece, set up and operate tool grinders installed near the machine, select and place tools in the heads, maintain tool and fixture inventories, and perform general area housekeeping. Some of this work can be done while the machine is on a long drilling cycle or during a 20-minute warmup period at the beginning of each new job.

are you stuck?

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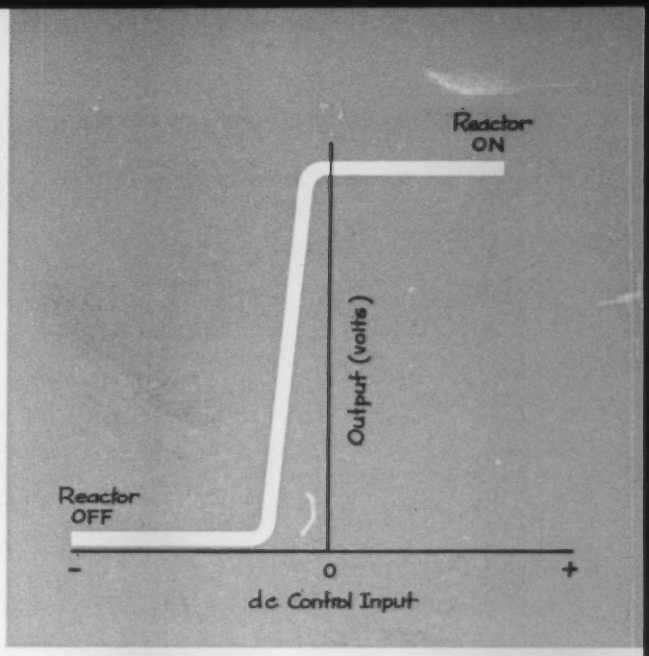


Fig. 1—Input/output characteristic curve example illustrates action of a static switching reactor with various levels of dc control input applied to control windings. Reactor is placed in its *off* state by application of negative control input. Output in this state is negligible. When control input is zero or positive, reactor turns *on* and supplies output to actuate a load. Basic logic functions can be provided by changes in modes of operation.

STATIC DELAY CIRCUIT

CONTROLS INDEX ACTION

Time delay is one of many logic functions that are readily provided through static switching means. A reliable, contactless switching reactor and an elementary resistance-capacitance network are the heart of a control circuit that provides this type of action. In the application described, the indexing of a traying attachment is controlled in synchronism with the discharge of parts from a forming machine.

By **JEROME E. VIELEHR,** Applications Engineer, Control, Div., Magnetics Inc., Butler, Pa.

STATIC switching reactors are finding increasing employment in industrial control applications. Their inherent ruggedness, absence of moving parts, and fast response to control impulses qualify them for use in a variety of automatic control circuits. All of the basic logic functions—*And*, *Or*, *Not*, *Memory*, and *Time Delay*—obtainable with conventional switching means can be provided by switching reactors. With switching reactors, translation of control inputs into logic operations occurs through changes in output impedance levels rather than the opening or closing of contacts.

Switching reactors are normally operated in one of two states, designated *on* and *off*, *Fig.* 1, depending upon whether or not sufficient output voltage is available to actuate a load. Operating state is determined by the magnitudes and polarities of dc control signals applied to multiple control windings. Typical loads are solenoids, motor contactors, magnetic clutches, and visual or audible alarms.

▶ Time Delay

An application of a static switching reactor in a circuit that provides voltage pulses of controlled duration to operate a solenoid is an example of use for time delay. Action is similar to that provided by a normally-open time-delay relay that closes for a predetermined time interval upon receiving a control signal.

Used in a vacuum tube manufacturing operation at the Emporium, Pa., plant of Sylvania Electric Products Inc., the time delay circuit co-ordinates the lateral movement of a traying attachment, *Fig.* 2, with the operation of a forming machine. Product units from the forming machine are discharged at intervals to the traying attachment. Trays placed in the attachment are divided into compartments, each of which receives one part. This is accomplished by indexing the tray laterally and longi-

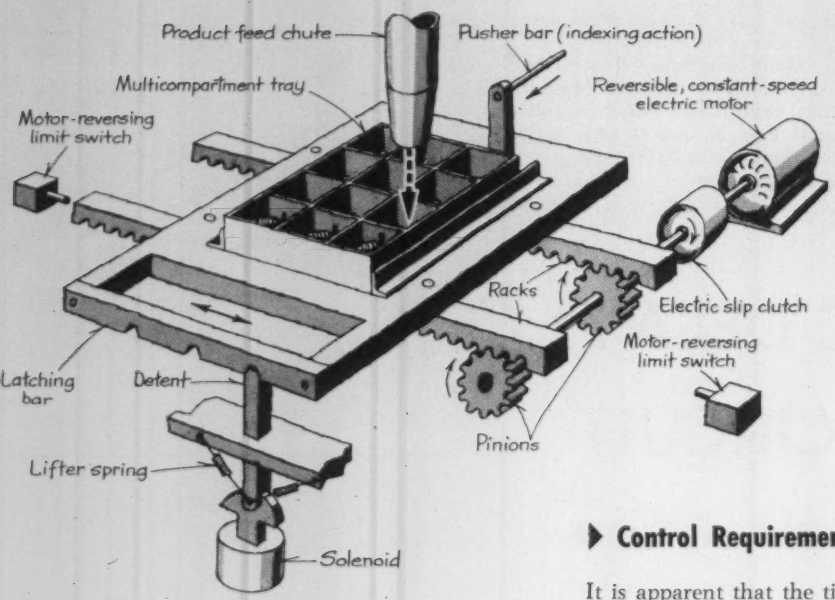


Fig. 2—Schematic diagram illustrates motions involved in traying attachment controlled by static switching reactor circuit. Solenoid is periodically energized for predetermined time to withdraw detent and permit side-to-side indexing of tray. Purpose is to present a separate tray compartment for each unit of product released from feed chute.

tudinally, in synchronization with the operating cycle of the forming machine, to present an empty compartment to the discharge chute each time a part is released.

The force that produces lateral motion of the traying attachment is obtained through an electric motor and slip clutch drive that operates a rack and pinion arrangement, *Fig.* 2. Motion is normally prevented by a detent that engages any of several notches in a latching bar. The detent is retracted by a solenoid.

▶ Limit Switch Actuation

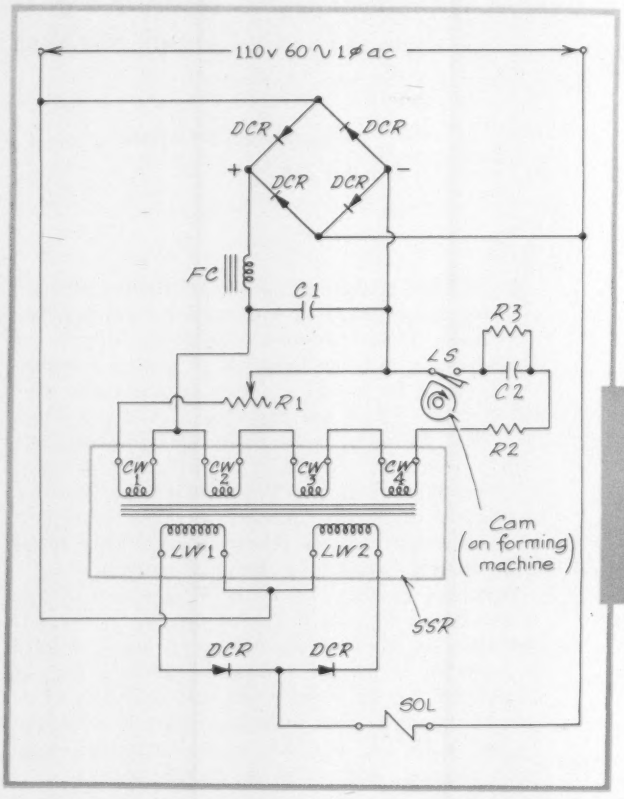
In operation of the system, a cam on the forming machine periodically closes a limit switch. Closing of this switch actuates the time delay circuit for the traying attachment, and the solenoid is energized for a predetermined interval. Energization of the solenoid retracts the detent, permitting the drive to move the traying attachment laterally.

If the direction of motion is such as to bring the next adjacent notch over the detent, the detent will engage this notch and stop the tray. In this manner, the tray is indexed laterally a distance of one compartment each time the forming machine ejects a part.

When the last compartment at either side of the tray has been indexed into position and filled, the next operation of the detent allows the traying attachment to be driven laterally beyond the tray boundary. A limit switch is thereby actuated that reverses the drive motor so that the same end notch in the latching bar will be engaged by the detent. However, longitudinal indexing of the tray, produced by the action of a pusher bar, has meanwhile indexed an empty compartment in the next row into position.

▶ Control Requirements

It is apparent that the time interval during which the solenoid is energized must be shorter than the time for the traying attachment to index one notch or to overrun, reverse, and return to the last notch at either end of the latching bar. Also, because the forming machine is operated at different speeds for different products, it was desirable that closing of the limit switch by the cam on the forming machine should initiate the solenoid action, but not



determine its duration. This avoids the need for changing cams each time the machine speed is changed radically. "One shot" actuation of the solenoid also prevents continuous indexing of the traying attachment if the forming machine should be stopped with the lifting portion of the cam holding the limit switch closed. This last feature is imperative, since the machine is unattended by operators.

▶ Circuit Details

The switching reactor control circuit that was devised, *Fig.* 3, provides voltage pulses to actuate the solenoid in accordance with the stated control requirements. Each time the limit switch on the forming machine is closed, the switching reactor turns *on*, delivering full output voltage to the solenoid. The reactor automatically turns *off* approximately 0.03 second later, even if the limit switch is still closed at that time. Generation of subsequent voltage pulses to actuate the solenoid requires that the limit switch open and close between each pulse. The circuit may be actuated by the limit switch at rates up to 7000 times per hour.

Initially, limit switch *LS*, *Fig.* 3, is open. A power supply circuit, including four dry contact rectifiers *DCR* connected in a bridge arrangement, and filter choke *FC* and condenser *C*1, supplies direct current for the control windings of static switching reactor *SSR*. Resistor *R*1 is adjusted so that the current in control winding *CW*1 is 17 ma. This input is negative, so that switching reactor *SSW* is held in its *off* state.

When *LS* is closed by the cam on the forming machine, current flows in control windings *CW*2, *CW*3, and *CW*4 through *R*2 and *C*2. These windings are connected in series aiding, and when current flows it is in a direction providing positive control input. This control input overcomes the negative control input applied continuously to control winding *CW*1, and *SSW* turns *on* to energize the solenoid.

However, as condenser *C*2 becomes charged, the charging current rapidly decays exponentially to very small values. This same current, flowing in control windings *CW*2, *CW*3, and *CW*4, drops to a value such that the smaller positive control input can no longer sustain *SSW* in its *on* state. The unit is turned *off* by the negative control input supplied by *CW*1, and the solenoid is de-energized.

With the switching reactor model chosen, and values of 10 mfd and 5000 ohms for *C*2 and *R*2 respectively, the process takes about 0.03 second. Increasing either *C*2 or *R*2, or both, would extend this time. Resistor *R*3, shunting condenser *C*2, dissipates the charge on the latter element during the portion of the operating cycle when the limit switch is open, so that charging current can flow when the limit switch next closes.

Advantage was taken of the fact that the static switching reactor chosen has several control windings. After winding *CW*1 had been committed for the *off* function, three control windings were available to provide positive control input to turn the unit *on*. By connecting these windings in series aiding, sufficient positive control input could be developed with smaller charging current than would be required for a single control winding.

The physical form of the control circuit is illustrated in *Fig.* 4. The switching reactor, provided by Control, a division of Magnetics Inc., is mounted on a chassis with the power supply and time delay components. The chassis is placed as a unit in the master control panel for the forming machine and traying attachment.

Success attained with this circuit has been such that Sylvania engineers have developed a standard switching reactor mount that can be used in future applications. The other logic functions—*And*, *Or*, *Not*, and *Memory*—will also be employed. In some cases a number of logic functions will be combined in one circuit using a single switching reactor.

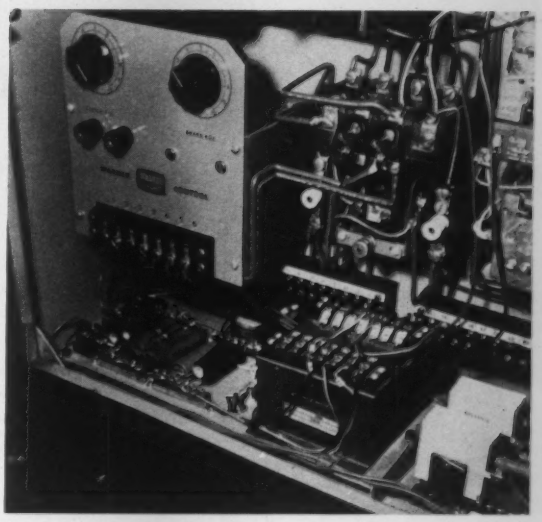


Fig. 4—Switching reactor control circuit components are mounted on separate chassis, foreground, placed in master control panel for forming machine and traying attachment.

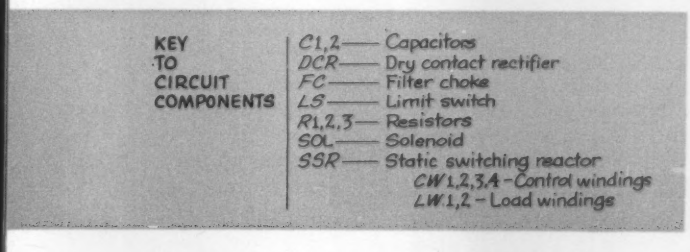


Fig. 3—Control circuit for traying attachment uses static switching reactor to provide voltage pulses of controlled duration to actuate solenoid. Action is initiated by closing of limit switch by a cam on forming machine that supplies product. Duration of pulses generated is approximately 0.03 second, determined by characteristics of reactor and values of *R*2 and *C*2.

- ELECTROHYDRAULICS
- ELECTRIC SEQUENCING

CONTROLLING LARGE FLOWS

KEY TO EFFECTIVE REFINING

Control of catalyst flow in a catalytic cracking unit and regulation of gas flow to a concentration unit are two operations in refinery processing that require fast corrective action in response to changes in process conditions. The application of electrohydraulic controls to catalyst flow and the use of automatic loading and unloading systems on a gas compressor have supplied a Canadian refinery with successful solutions to both problems.

By **ROBERT E. URBAN,** Engineer, Procon Inc., Des Plaines, Ill.

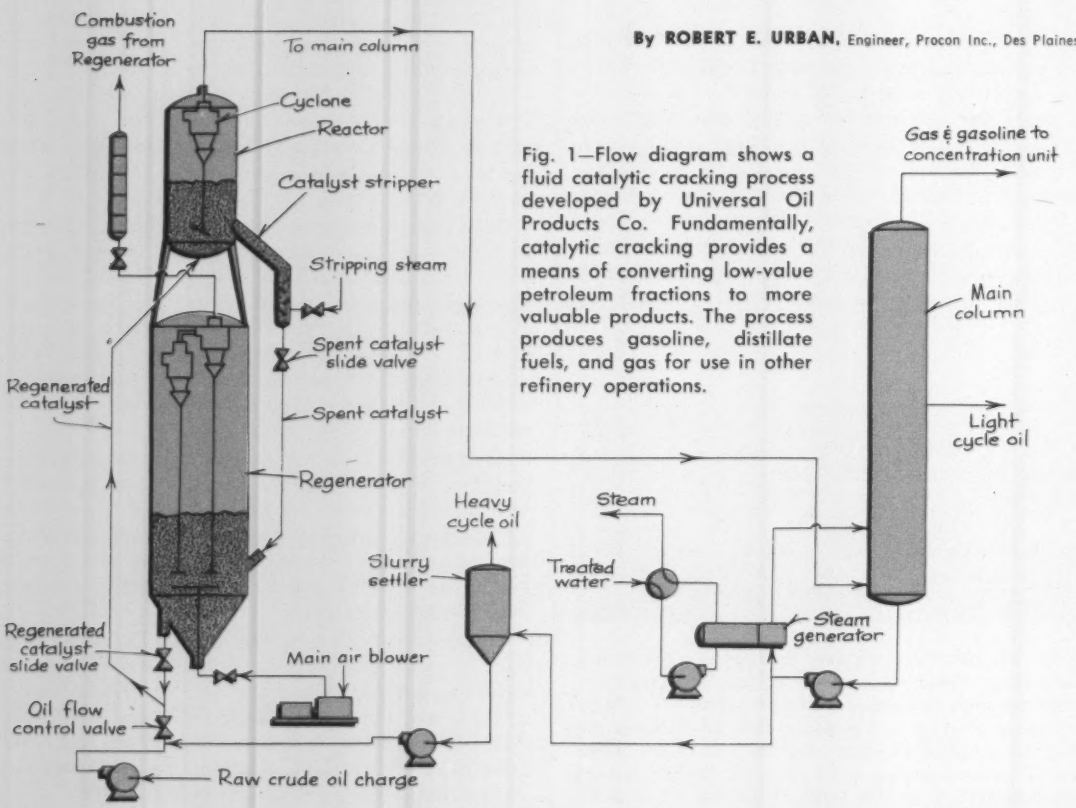


Fig. 1—Flow diagram shows a fluid catalytic cracking process developed by Universal Oil Products Co. Fundamentally, catalytic cracking provides a means of converting low-value petroleum fractions to more valuable products. The process produces gasoline, distillate fuels, and gas for use in other refinery operations.

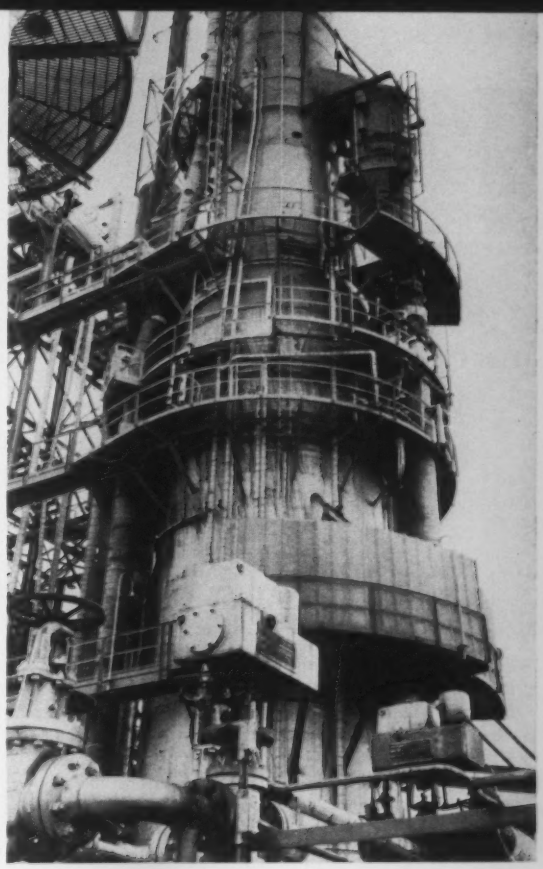


Fig. 2—This fluid catalytic cracking unit has a design capacity of 7000 barrels per day of crude oil charge. The oil charge is subjected to heat and pressure in the presence of a catalyst and breaks down into gasoline, gas, and oil fractions. Catalyst circulates between the reactor (top) and regenerator (bottom) at a rate of 15 tons per minute. In the foreground are two of the many GPE Controls Inc. electrohydraulic valve positioners used on process lines.

SEVERAL YEARS AGO Regent Refining (Canada) Ltd., a subsidiary of Texaco Canada Ltd., was considering various control techniques for a new 7000-barrel fluid catalytic cracking unit for its refinery at Port Credit, Ontario, Canada. Since this refinery operates for long periods in icy temperatures, the design engineers were concerned with the possibility of moisture condensation and subsequent freeze-ups in tubing lines which normally are used to link control instruments to critical control valves. Therefore, the company became interested in methods employing electrical means to close the control loop, eliminating the necessity for exposed tubing systems.

Prior to the design of the new catalytic cracker, the refinery added a crude-distillation unit which served as a testing ground for various tubeless methods of process control. This crude unit precedes the catalytic cracker in the refining process and performs a distillation process in which crude oil is vaporized and various fractions—heavy gas oil, light gas oil, gasoline, and naphtha—are drawn off. The heavy gas oil is then sent to the cracking unit for further transformation of part of it into gasoline.

Pneumatically operated control valves were used at the time of the crude unit installation. However, the engineers mounted electropneumatic conversion units at each valve to convert electrical signals from process controllers to pneumatic outputs to drive the valve motors. Performance of the electrical instrumentation on this unit indicated that this type of control system would accomplish the objective of fast and accurate response to changing operating conditions. At a later date, when electrohydraulic valve actuators became commercially available, one of the pneumatic components was removed from a valve in the crude unit, and a test was run using the new type actuator. Since the electrohydraulic device permitted a direct conversion from electrical signal to valve actuating means, it was considered a definite improvement over the electropneumatic conversion system previously tested.

Based on the successful operation of the crude unit electrohydraulic control system, the company "went all out" for electrical instrumentation in the design of the new fluid catalytic cracking unit. Not only were all the instruments to be controlled by electricity, but all the control valves were to be electrohydraulic. As finally designed, the catalytic cracking unit and its fractionation section, as well as the gas-concentration section and a polymerization unit, were all provided with electronic control. Process design for all units was furnished by Universal Oil Products Co., parent corporation of Procon Inc. Mechanical design, procurement, and field erection were handled by Procon (Canada) Ltd.

Fluid Catalytic Cracking

Flow diagram for the UOP Fluid Catalytic Cracking process is show in *Fig.* 1. In this process heavy gas oil from a crude distillation unit is subjected to heat and pressure in the presence of a catalyst which promotes the conversion reaction. Fluid catalytic cracking gets its name from the fact that the catalyst is in the form of finely divided particles which flow through the reactor and the regenerator like a fluid. The heavy gas oil and the catalyst are mixed in the regenerated catalyst riser and further mixed in the reactor where the cracking reaction occurs.

During the cracking process, the catalyst becomes coated with coke which inhibits the catalytic action and must be removed to maintain the efficiency of the operation. Therefore, the coated catalyst is separated from the oil and re-

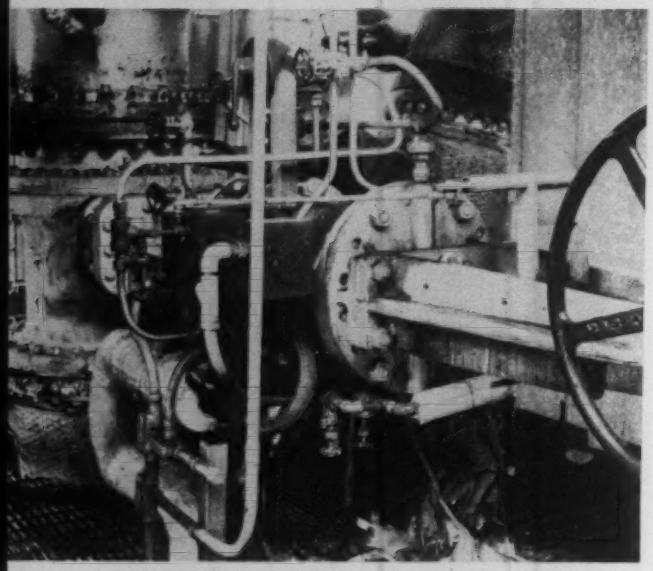


Fig. 3—Temperature in the reactor of the cracking unit is maintained at approximately 900F by increasing or decreasing the flow of regenerated catalyst with this electrohydraulically operated slide valve. Close control of the catalytic cracking unit is of the utmost importance to prevent clogging of circulation lines and reversal of flow which could lead to explosions.

action products in the reactor and flows into the regenerator where air is introduced to burn the carbon off the catalyst. The clean catalyst then flows out of the regenerator, meets the incoming heavy gas oil stream, and re-enters the reactor. In a 7000-BSD cracking unit (meaning that oil is fed into the unit at a rate of 7000 barrels per day), the catalyst circulates at a rate of about 15 tons per minute.

Importance of Control

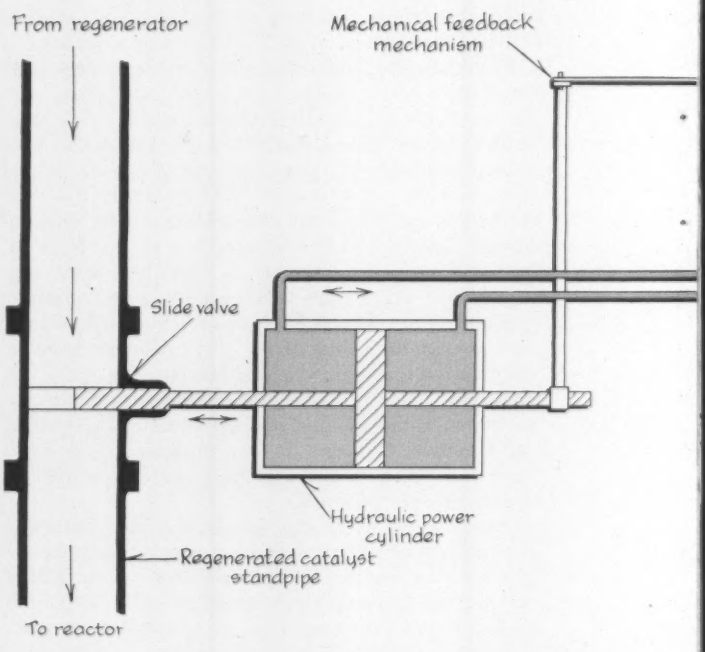
The temperature in the reactor of the cracking unit should be held at approximately 900 F. Coated catalyst enters the regenerator and is heated to approximately 1100 F as the coke is burned off. The heavy gas oil charge is heated to about 500 F before it enters the reactor. Proper reactor temperature is maintained by varying the flow of the regenerated catalyst.

Control of the catalytic cracking unit is of the utmost importance to prevent the possibility of explosions. With hot air entering the regenerator, and with hot oil and gasoline in the reactor, control devices must be sensitive and capable of reacting fast to prevent dangerous situations. For instance, the flow of spent catalyst from the reactor to the regenerator, although it is varied according to the heat demands of the reactor, must be held within limits. Too small a spent catalyst flow could allow hot air to flow from the regenerator into the reactor via the catalyst stripping line. Similarly, clean catalyst leaving the regenerator and entering the oil charge line must be controlled carefully. If the catalyst plugged the oil line, oil could enter the regenerator with the chance of an explosion.

Electronic Control System

The fluid catalytic cracking unit, *Fig.* 2, was designed for a reactor charge rate of 7000 barrels a day of heavy gas oil and to operate at a conversion level of 70 per cent. Coke burning capacity in the regenerator is 9000 pounds per hour. The high octane gasoline produced is used as a blending compound in motor fuels. The reactor temperature is controlled by positioning a slide valve located on the output standpipe of the regenerator, *Fig.* 3. Movement of this valve varies the amount of clean or regenerated catalyst that flows into the oil charge line leading to the reactor. With catalyst circulating at a rate up to 15 tons per minute, small changes in the position of the slide valve affect the temperature considerably, and the rate of change in temperature is quite high. By using electronic control, any change in reactor temperature is sensed by a thermocouple and is fed into a controller as an unbalanced voltage for immediate correction of the regenerated catalyst slide valve position.

Since there is no transfer of measurement from an electronic measuring circuit to a mechanical system, such as would be required when using a pneumatic system, smaller changes in temperature can be detected and used to actuate the control circuit. This permits quicker detection of a change in reactor temperature and permits corrective control action



sooner than is possible with normal pneumatic control.

A second major area of control in a fluid catalytic cracker is the reactor catalyst bed level. Flow of coated or spent catalyst between the reactor and the regenerator must be maintained within limits to prevent hot air from entering the reactor through the catalyst return line. This is accomplished by a reactor bed level control which positions a slide valve in the spent catalyst return line.

The flows of the regenerated catalyst and the spent catalyst are regulated by slide valves which are operated by electrohydraulic valve actuators, *Fig.* 4, manufactured by GPE Controls Inc. The actuators are controlled electrically from a central control panel. Such a system eliminates the necessity of running tubing from the control instrument to the valve. This is especially advantageous in cold climates since the cost of building tube racks for protection against weather, corrosion, and mechanical damage is a major part of the installation cost. The electrohydraulic valve actuator also eliminates considerable maintenance that would be required in tubing systems to check for leaks due to mechanical vibrations and temperature changes.

A typical electronic control loop for the catalytic cracker control valves is shown in *Fig.* 5. The valves are arranged so that a control signal of 4 milliamperes will close the valves, and an 8-milliampere signal will open the valves. Each of the valves is provided with a differential pressure overriding control. Normally, the electronic controllers would position the slide valves in order to maintain the proper temperature and bed level in the reactor. However, in the event that the differential pressure across either of the slide valves drops below a safe level, the differential pressure controller takes away control action from the master controller to prevent losing the differential across the valve altogether and causing a reversal of flow. The reactor temperature controller and the corresponding differential pressure controller feed signals into a device known as an underride unit. Normally, the differential pressure controller output is at a maximum, and the temperature controller's output is something less than this. The underride unit has an output which is exactly equal to the lowest of its two inputs. In the event that the differential pressure drops below the set point, the output of the differential pressure controller will drop. In dropping below the output of the temperature controller, it will then be fed through the underride unit to the control valve, taking control away from the temperature controller. The reactor bed level control also works through its corresponding differential controller in exactly the same manner.

▶ Compressor Control System

Another interesting control system used at the Port Credit refinery is the control of a reciprocating gas compressor used in the gas concentration unit. This unit is where various gases such as propane, propylene, butane, butylene, and isobutane are collected and separated according to the individual refinery equipment. The gases can be burned as a fuel, marketed as light process gas, used in making polymer and alkylate gasoline, and used for other purposes.

The various gases—light hydrocarbons produced as a byproduct in gasoline production — flow from the fluid catalytic cracker reactor to a separation column that removes gasoline and oil fractions. The remaining light gases are then pumped to the gas concentration unit. The purpose of the reciprocating gas compressor is to compress the gases prior to entry into the gas concentration unit. The amount of gas to be compressed varies according to operating conditions of the catalytic cracker, the charge stock used, and other operating factors. The control system of the reciprocating gas compressor is

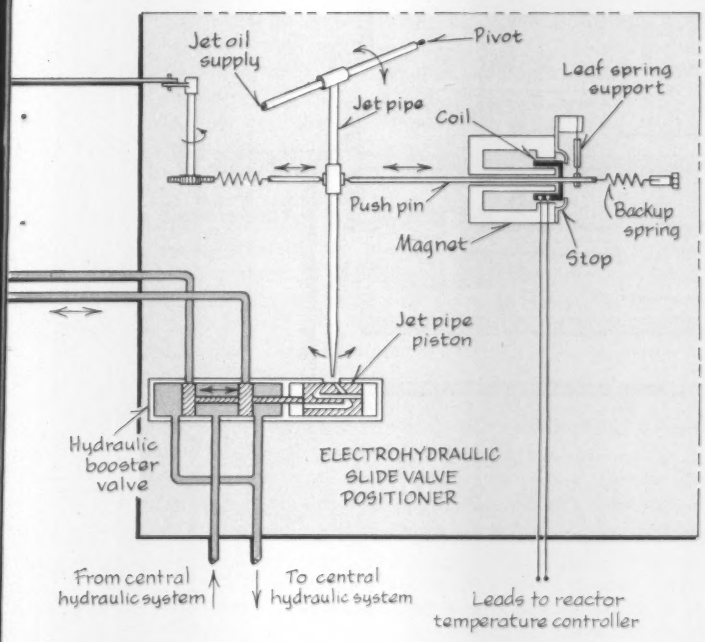


Fig. 4—Electrohydraulic slide valve positioner controls the regenerated catalyst slide valve through a hydraulic power cylinder. Signals from a temperature controller cause a coil to move in the field of a permanent magnet and deflect a jet pipe. Oil is pumped through the jet pipe at pressures of 100 to 400 psi. Deflection of the jet pipe causes pressure to increase in one hole of the jet pipe piston and to decrease in the other, moving the piston and the attached 4-way valve. Oil from a central hydraulic system then circulates to the hydraulic power cylinder and causes the attached slide valve to change the flow rate of regenerated catalyst through the standpipe. Movement of the hydraulic power cylinder piston is fed back to the jet pipe by the mechanical linkage and causes the jet pipe to return to its neutral position, stopping the slide valve when the desired position is reached.

used to vary its capacity in accordance with the varying quantities of gas pumped to it.

A schematic diagram of the reciprocating compressor is shown in *Fig.* 6. The unit contains four double-ended cylinders, each having a piston which alternately compresses gas at both ends of the cylinder. Thus, in effect, the unit consists of eight compressor sections. To maintain a constant pressure the compressor is loaded and unloaded by automatically controlling the position of the intake valve of each section. This allows the capacity of the unit to be changed in steps of 12½ per cent of the total capacity. Additional control of the compressor is provided by a bypass control valve which permits loading and unloading in steps smaller than 12½ per cent for final balancing.

A sequencing circuit controls the operation of the eight intake valves so that the various compressor sections are added and removed from the system in accordance with the current demand. For example, assume the process requires 60 per cent of the total capacity of the machines. The closest cylinder loading to this would be 62½ per cent. Therefore, the machines will be so loaded, and the bypass valve will bypass the extra 2½ per cent. The sequence timer will remain de-energized as long as the bypass valve can handle the changes in load. Only if the bypass valve reaches a position less than 10 per cent open or more than 90 per cent open will the timer circuit be energized. If the load requirement changes to

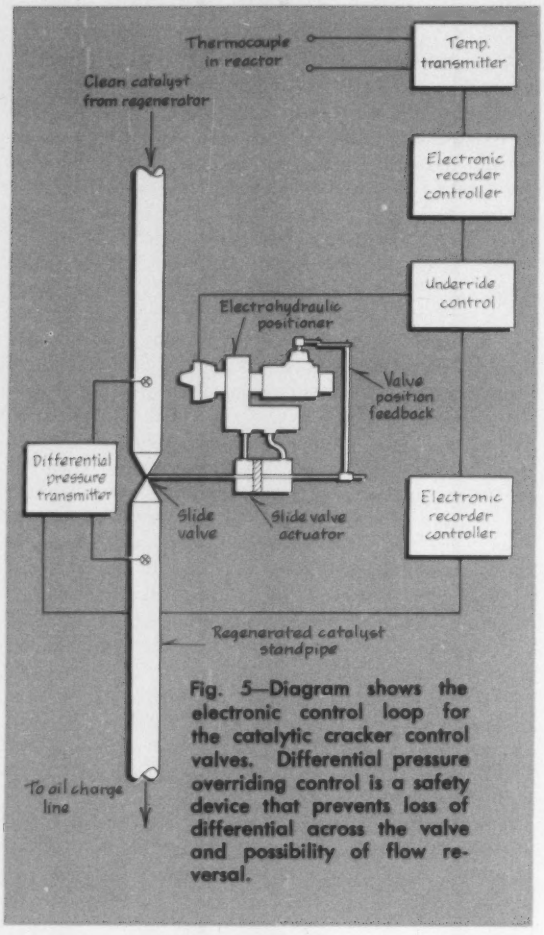


Fig. 5—Diagram shows the electronic control loop for the catalytic cracker control valves. Differential pressure overriding control is a safety device that prevents loss of differential across the valve and possibility of flow reversal.

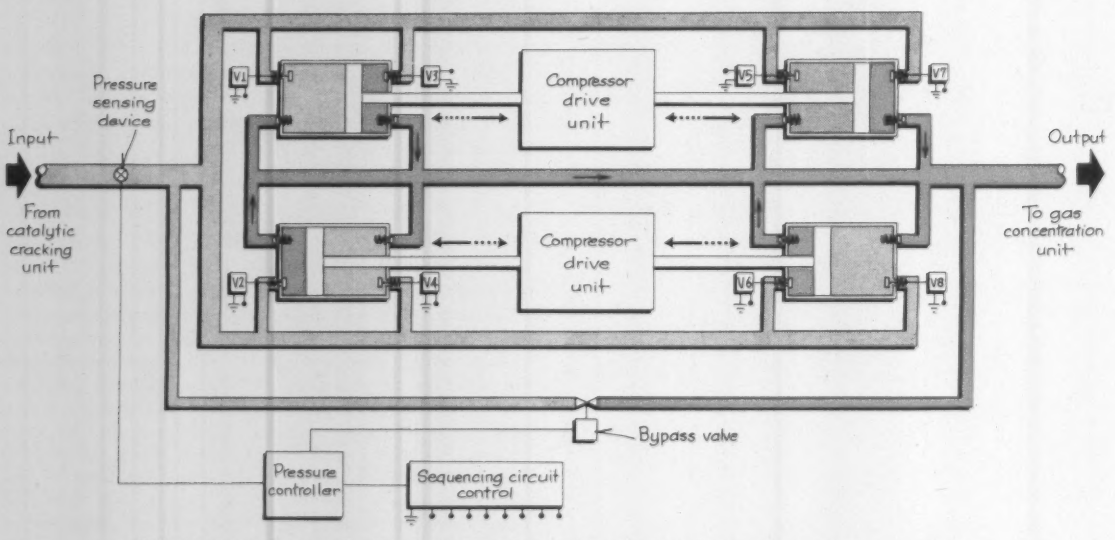


Fig. 6—Sequencing circuit control automatically changes the reciprocating compressor output in steps of 12½ per cent of rated capacity in order to maintain a constant input pressure from the catalytic cracking unit. Bypass valve will change capacity up to 12½ per cent, and additional capacity is added or removed from compressor by controlling the input valves to the compressor sections.

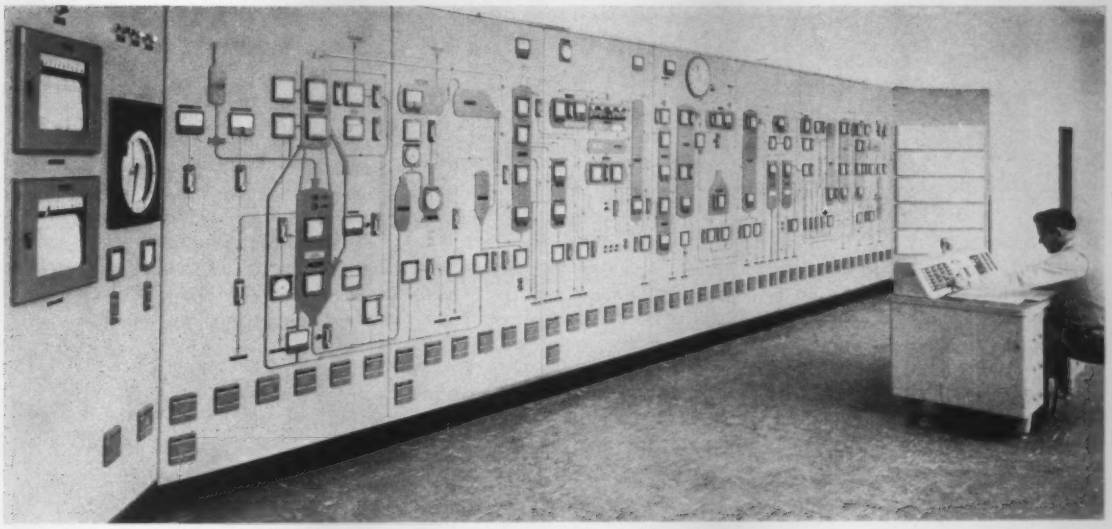


Fig. 7—Catalytic cracker, fractionator, gas recovery unit, polymerization unit, and other refinery sections are controlled from this central graphic panel. Many of the recorders and controllers used in this panel were furnished by Swartwout Co. Rapid checking of electronic instrumentation by plug-in meters and substitution of plug-in components makes this equipment easy to calibrate and provides greater accuracy.

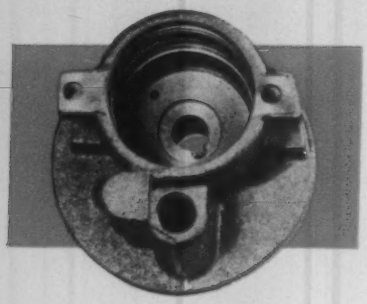
45 per cent, the bypass valve will open more and more, trying to bypass the extra 17½ per cent (62½-45). In trying to do this, it will open wider than 90 per cent and energize the sequence timer which will unload one cylinder reducing the machine capacity from 62½ to 50 per cent. Now the bypass valve need only bypass 5 per cent, and it repositions itself to do this. If it closes to below 90 per cent open as it will in this case, the timer is de-energized, and conditions become stable. If the load change were greater and conditions did not stabilize, then, after a period of 10-12 seconds, the sequence timer would unload another cylinder. This would continue until the machine was properly loaded, and the bypass valve was bypassing something less than 12½ per cent.

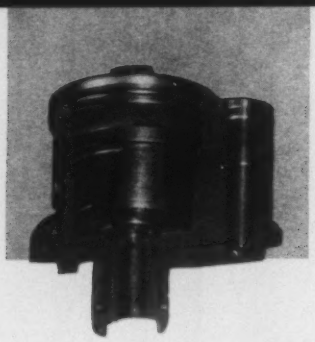
In the event the load requirement goes up, the suction pressure will go up, and the bypass valve will begin to close. As long as the load change can be handled by the bypass valve without its closing to less than 10 per cent open, the sequence timer will remain de-energized. If this cannot be done, then, when the bypass valve goes below 10 per cent open, the sequence timer is energized. The sequencer has a reversing stepping switch so that it can either load or unload cylinders as required. In this case the sequencer begins to load the cylinders until the machines are handling slightly more than the process requirement, and the bypass valve comes open to a point greater than 10 per cent. At this point the process is again stable. This procedure is exactly the same as that described above except that the sequencer is energized to load instead of unload the machines. Lights at a control board indicate the automatic loading and unloading of the machine. The machine may also be loaded or unloaded manually by switches on the control panel without upsetting the process.

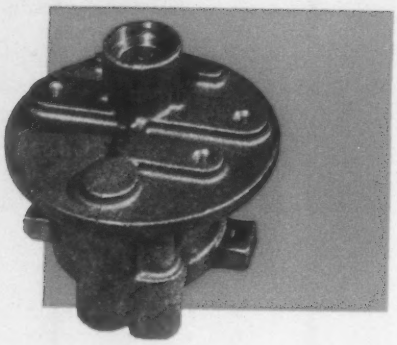
▶ Greater Use Predicted

In general, the other electronic control systems at the refinery are analogous to pneumatic systems. The major design difference between the systems is the location of the control instruments for flow control. In the case of pneumatic systems, the control instruments are usually field mounted in order to make a fast loop. With electronic flow control, using electrical impulses instead of air as an actuating means, the controllers are mounted in a central control house, *Fig.* 7, rather than in the field.

The operation of the Port Credit refinery is a big step in evaluating the theoretical advantages of electronic control systems for this type of process. Refining is a science, but it is an extremely delicate one. Operating conditions must be held within strict limits to produce products of desired quality and quantity specifications. This fact underlines the importance of selecting a control system capable of fast response and extreme accuracy. A rule of thumb indicates that a 30,000 barrel per day refinery can afford to invest a quarter of a million dollars in controls alone if the system efficiency can be increased only one-half of one per cent. Under these circumstances, electronic controls with their reliability, economical installation, fast response and operation, and lower maintenance costs have certainly "cracked" the door in the refinery industry and will find greater use in years to come.







MACHINING PUMP HOUSINGS

- QUANTITY
- ACCURACY
- FLEXIBILITY

IN A TRANSFER MACHINE

By **MICHAEL ZAJAC,** Vice President, Engineering, Buhr Machine Tool Co., Ann Arbor, Mich.

BOTH high production rates and high accuracies are frequently desired in a production operation. But few buyers of transfer machines expect to obtain a production rate of over 200 parts per hour and hold part dimensions to ten-thousandths of an inch. A machine, *Fig.* 1, built by Buhr Machine Tool Co., performs 115 operations on hydraulic pump housings at a rate of over 200 parts per hour and holds some part dimensions to ten-thousandths. Not all the operations are precision machining, but some dimensions, including the flatness of a recessed step, are held to ten-thousandths. Smoothness of some surfaces is held to 70 microinches rms.

Distinguishing features of this machine are the tolerances specified for the product and the pallet-type fixtures used to obtain those tolerances. Neither the basic machine nor the workpiece is particularly unusual. The part is a casting requiring operations which include drilling, boring, grooving, spot-facing, reaming, chamfering, and tapping. The basic machine is made up of standard Buhr building-block components to provide 26 in-line stations —one for loading and unloading, 16 for working operations, and 9 idle stations. Fixtures with machined parts are returned to the first station by a return conveyor arrangement which passes through a washing machine.

Fixtures Are the Key

Although fixtures on many machines have been built by cut-and-try methods, these were fully engineered and fabricated by mass-production techniques. The parts of the fixtures were made to engineering drawings and are interchangeable. Many of the fixture dimensions are held to limits specified in ten-thousandths of an inch.

Considerable attention was given to minimizing wear on critical surfaces and to providing means for checking the fixtures. As the fixtures are transferred through the working stations, they are slid on accurate ways. They are located in each station by two shot pins and are clamped at four points with fulcrum-wedge clamps. To reduce wear on the ways of each fixture, cam followers are used as wheels to carry the fixture along the return con-

veyor. Gage blocks were built into the fixtures to aid in their inspection and to provide reference surfaces for spot-gaging of workpieces to check the accuracy of work being performed. These checks are made with the parts clamped in the fixtures, and they give an accurate indication of machine and tool conditions, as well as condition of the fixtures.

To fill the 26 in-line stations and the 14 spaces on the return conveyor, 40 fixtures are required. Two extra fixtures were supplied with this machine so that fixtures can be inspected, and reconditioned if necessary, without disrupting the output of the machine. At the option of the operator, any fixture can be removed as it passes a given point on the return conveyor. A hydraulic ejector removes the fixture from the conveyor and simultaneously moves one of the reserve fixtures onto the conveyor. The ejected fixture is located in the checking station by two shot pins and clamped on ways just as if it were in a working station. Gage blocks built into the checking station and those in the fixture can then be used to check out all critical fixture dimensions. Minor maintenance work can be performed right in this checking station. If major repairs are required, the fixture can be taken to a repair area. If replacement of fixture parts should be required, new ones can be produced according to the standard blueprints.

Fixtures are automatically lubricated at the load-unload station. The slide, which advances a power wrench to clamp and unclamp the workpieces, also carries a coupling device that connects a lube pump to lubricating lines on the fixture. When the joint has been made, the pump starts and continues to run until a preset pressure has been built up in the lines on the fixture. If this pressure is not reached, the machine cannot cycle until the fault is corrected.

▶ Provisions For Precision

The most important surface in machining this workpiece is the bottom of the bore. This surface acts as the master reference point for all part dimensions and tool calculations. The depth of this surface is held to close tolerances, and its flatness is held within a few ten-thousandths of an inch. The finish on this surface is 70 microinches rms.

In another operation, hole tolerances are maintained to a few ten-thousandths by holding reamer tolerances to ten-thousandths. A floating bushing plate is used to accurately locate the pattern for two pin holes, from the pump-housing bore, in their finish-reaming station. Center distances in other hole patterns are held within plus or minus 0.001 inch.

Whenever possible, combination tools are used to minimize problems in establishing relative dimensions. This problem is further complicated because each fixture carries two workpieces. Therefore, each head carries two sets of tooling.

To facilitate tool maintenance, three tool control boards have been strategically located in the machine installation to make tool changes fast and convenient. After sharpening or replacing of inserts in the toolroom, the tools are brought to the boards, where they are preset with built-in gages to match tool print requirements. At all times, a complete set of preset tools is at hand in the boards.

The precision obtained for these operations is not

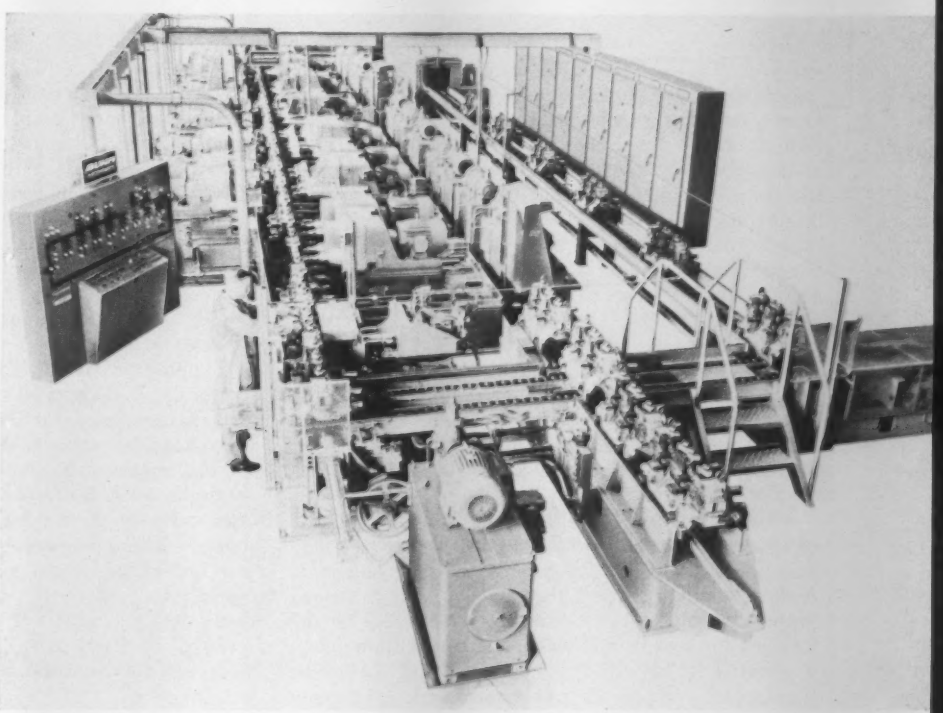


Fig. 1—Castings for hydraulic pump housings are carried on pallet-type fixtures through the 26 in-line stations of this machine and returned to the starting point by a conveyor system. Every 24 seconds a fixture carrying two workpieces can be returned to the load-unload station.

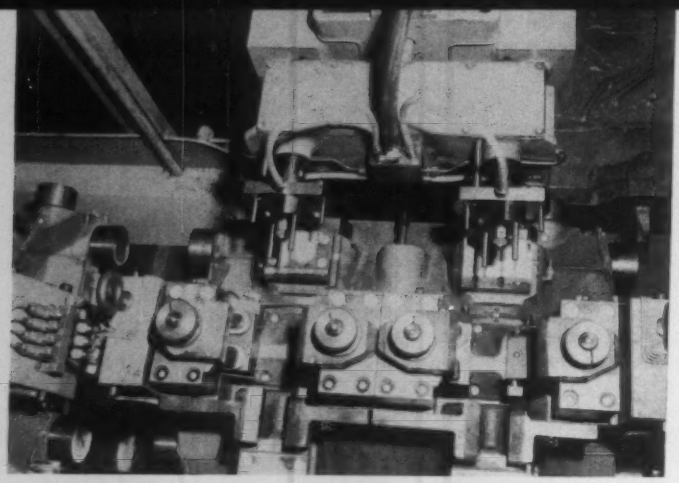


Fig. 2—Viewed from above, a typical probing station is shown with an unloaded fixture in position. If a probe fails to travel to full depth, the machine is shut down until the fault indicator for that probe is reset. The probe which has been tripped is indicated on the control console by a red light.

spectacular, but it does reflect steady progress in the building of transfer machines. Though production operations have not been revolutionized by the building of this machine, a new definition for "normal" accuracy may now be necessary. Nevertheless, since excessive accuracy is wastefully expensive, product designers should continue to call for only the accuracy they need to satisfy the requirements of the product.

Operating Cycle

The operator manually loads two parts in a fixture and presses two pushbuttons. A hydraulically operated arm advances to locate the parts in the fixture, and an air-powered wrench tightens clamps holding the workpieces in the fixture. The wrench is advanced to the fixture on the slide of a standard feed unit.

After all units have been to depth and retracted in the cycle being performed, shot pins are withdrawn and fixture clamps released. If the pushbuttons were not pressed the machine will stop at this point. Since the pushbuttons were pressed, the transfer bar then rotates to engage the transfer fingers with the fixtures and advances all fixtures one station. The transfer fingers are rotated out of engagement and the transfer bar retracted. The shot pins are advanced; the fixtures are clamped; and the machining heads are cycled. The entire cycle takes 24 seconds.

Longest cycle of any machining head is 16.5 seconds. This includes the generating heads for facing and grooving operations. These heads have a regular infeed by the hydraulic feed unit and an auxiliary radial feed produced by a separate hydraulic cylinder.

Thirty probing operations are included in the machine to prevent tool and workpiece damage that could be caused by broken tools or failure to feed to depth at a preceding station. In a typical probe operation, *Fig.* 2, the probe advances to the forward limit of its stroke; after a preset time delay, a green light glows on the console; and the probe is retracted. When the probe meets an obstruction, the probe slide completes its advance and retracts, but the probe does not make its depth switch. The fault is indicated on the console by the glow of a red light, and before the machine can be recycled a reset button must be pushed at the probe station. The operator makes necessary tool replacements, removes the defective part, resets the probe, and the machine is then ready to cycle again.

The machine is built as a closed loop, and the advance of the return conveyor system is co-ordinated with the in-line transfer. At each index of the transfer bar, a fixture with two finished housings is deposited at the load-unload station by the return conveyor. The air wrench is automatically advanced and loosens the clamps so the operator can unload the machined units and load two raw castings.

Flexibility for Future Needs

Some of the working stations are idle on one side. In addition, nine completely idle stations have been included. Provision of these idle points serves two purposes. Current tooling is easy to get at, and there is plenty of room for future requirements. Fixture locators and clamps are already provided in idle stations, and the bases are machined and ready to accept additional tool feed units. The idle stations can also be set up for automatic in-process gaging. This would just be a matter of mounting suitable gage heads.

Tapping heads have been mounted on standard hydraulic feed units so that present tapping stations can be converted for drilling or boring operations. The standardization achieved on hydraulic feed units in this machine is attested by the fact that of the 21 units used, 9 are of one size and 12 of a second size. Seven of the heads used have change-gear boxes. Though present ratios used are 1 to 1, they can be easily changed to operate at optimum cutting speeds for different tool materials, hole sizes, or workpiece materials. Finally, because of its standardized sectional-base design, the machine can be economically reworked for changing production requirements.

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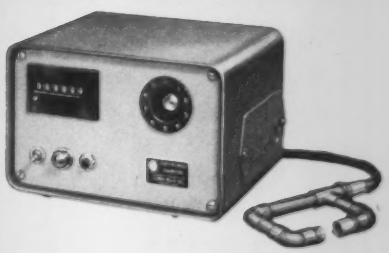
New High-Speed Predetermining Counter, Series 1522, features instant lever reset plus quick and easy setting of predetermined number. Speeds up to 6,000 rpm. Also supplied without predetermining feature.



New "Count-Pak", a complete electronic counting package for use where high speed, long life and instant reset are required. Rated at 20,000 counts per minute (with added decade speeds run up to 200,000 cpm). *Completely transistorized*. Photohead adaptable to any job. Several other "Count-Paks" available.

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Circle 690 on Page 17

WE'RE LEARNING WHY TWO EARS ARE BETTER THAN ONE

Which speaker is making the sound? In echoless chamber at Bell Labs, Robert Hanson measures test subject's ability to localize sounds — observes how two ears operate in partnership. This and other tests may point the way to better telephone instruments.

In listening to stereophonic music, how is it that our ears and brain construct a picture of the entire orchestra with but two samples (the sounds from two speakers) to work with?

How is it that our ears and brain are able to pinpoint *one* voice in a roomful of talkers—to listen to it alone and ignore the rest?

What makes *two* ears better than one?

Bell Telephone Laboratories scientists are searching for the answers. For in finding them, better telephone instruments and better ways of transmitting sound will surely result.

Our hearing performs feats that no electronic system can yet duplicate. How? Laboratories scientists believe the secret lies in the way our two ears function in partnership and in the way our neural network connects them with our brain. *The problem:* to discover what functions the network performs and to see whether electronic duplication might enhance understanding.

The work is under way. Electronic circuits that simulate the operation of nerve cells have already been created—and conceptual models of the neural network are being constructed.

Alexander Graham Bell's interest in deafness and hearing led to the invention of the telephone. Bell Laboratories' current explorations in binaural sound may well lead to important new advances in the transmission of speech and music.

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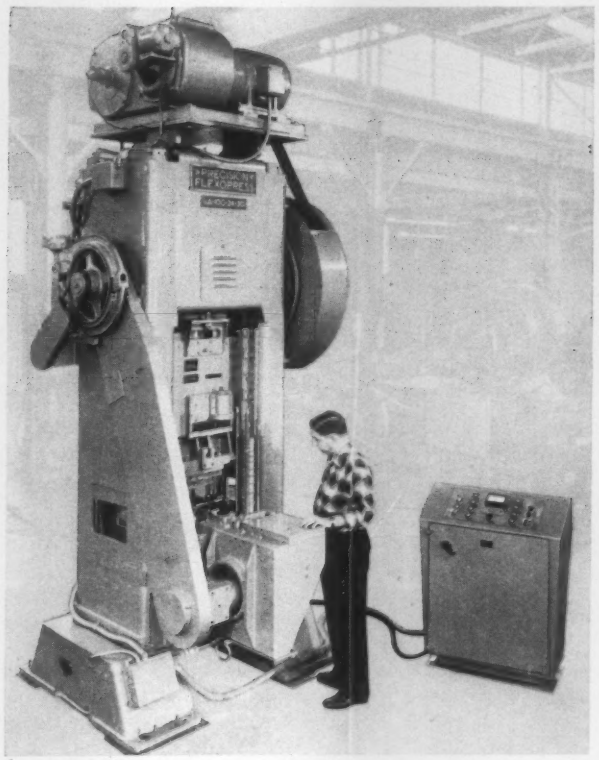
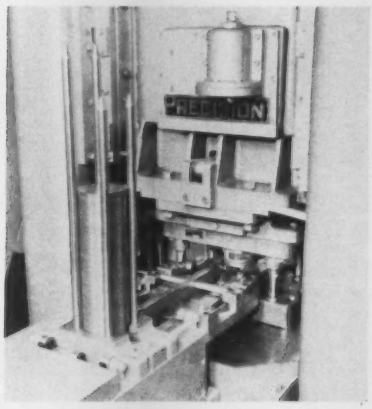
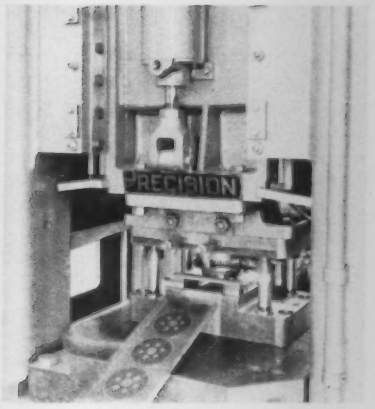
For detailed information and literature, use card on page 17.





Stacked, circular blanks are fed automatically to die by feeding unit.



Perforated laminations are discharged from press at the rate of 300 per minute.

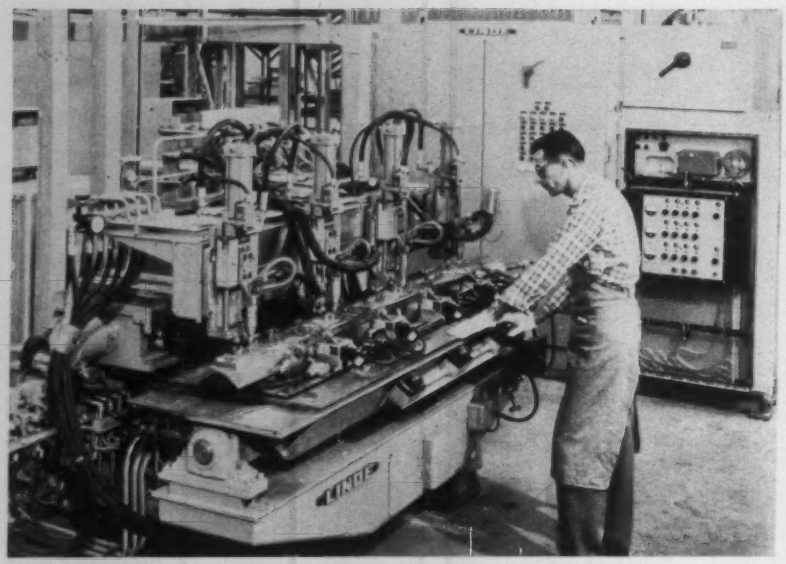
Integral Feeder Services Vertical Press

CIRCULAR rotor lamination blanks are perforated at the rate of 300 parts per minute in a 100-ton vertical press designed by **Precision Welder & Flexopress Corp.**, 3520 Ibsen Ave., Cincinnati, Ohio. Press features six preloaded ball bearing gibs that guide the ram. The gibs require no clearance for lubrication, and confine the ram so as to prevent sideplay and maintain positive alignment of the punch and die.

The 0.025-inch silicon steel laminations are produced by a punch and repunch method in two presses. First, circular blanks are stamped from sheet or strip in a blanking press. They are then stacked and fed individually to the 100-ton press that punches slots and holes. A feeding unit on this press uses spring-loaded fingers in reciprocating and stationary guides to slide the blanks off the bottom of the stack and into the die. The feeder is powered by a timing chain coupled to the crankshaft of the press.

If two blanks stick together and are fed into the die, a detector automatically stops the press cycle before any damage can occur. It operates by sensing deflection of the press flywheel by as little as 0.010-inch additional stock thickness. When excessive deflection occurs, the detector instantly disengages the flywheel air clutch.

Circle 401 on Page 17



Programmed Torch Welder Has Four Heads

Item 402

A tape-controlled, automatic spot welding machine developed by **Linde Co., Div., Union Carbide Corp.**, 426 Lexington Ave., New York 17, N.Y., is used at Convair, Div., General Dynamics Corp., Pomona, Calif., to produce missile parts such as control and dorsal fins. It has four torches, can produce up to four identical parts at one time. Up to 2520 spot welds per hour are possible. The Heliarc spot welding method used requires access to only one side of a joint, is suitable for joining parts in which two or more surfaces must be welded to a core. Welds are produced by tungsten electric arc, shielded by inert argon gas. The heat on the arc melts the metals through the joints, so the second side does not have to be accessible. This method is advantageous when it is impossible to reach the underside of the joint; when it is necessary not to mar or depress the underside of the joint; or when the bottom piece of the joint is thicker than the top piece by more than a 4:1 ratio.

The machine includes two slides mounted at right angles to one another and supported on a base. The slides are controlled by a program control unit to position the torches on the *X* and *Y* axes. Slides are positioned by means of piston-type hydraulic motors operating through suitable reduction gears and ball bearing lead screws. A horizontal beam, mounted on the upper slide, provides mounting surfaces for auxiliary vertical slides used to raise and lower the welding torches on the *Z* axis. Tooling used to locate and restrain the weldment is attached to the flat surface of a platen. The platen is mounted on trunnion bearings so that the workpiece can be adjusted to maintain the proper angle to the electrodes. Torches are mounted on linear ball bearing slides which are pneumatically operated by individual air cylinders. Each torch covers a 20 by 20-inch area; these areas are adjacent, so the four torches cover a 20 by 80-inch area. The repetitive accuracy of the machine permits relative positioning between torches and workpiece within 0.001-inch cumulative error for all three planes.

The program control unit supplies information to effect *X*, *Y*, and *Z* axis positioning of the torches and to control the sequence of operation of the machine and welding cycle. System contains a Flexowriter electric tape-punching typewriter and a tape-reading system. Movement of the machine to a position is determined by two types of electrical signals. One signal indicates the position to which it is desired to move. The second signal indicates the actual position of the machine. As the machine moves toward the desired position, the difference between the two signals is reduced to zero when the desired point is reached.

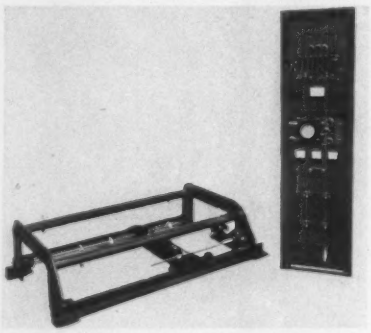
Circle 402 on Page 17

Web Motion Gage

Item 403

Instrument is capable of measuring the lineal feet of ferrous strip material passing a fixed point. It is suitable in tin-plate and cold strip mill operations or for conveyor speed measurements. The device can record the distance in footage in an 8 to 1 range of operating speeds with a degree of accuracy of better than 0.1 per cent. Heart of this device is an electronic servo system which is used to compensate for variations in distances between magnetic pulses due to delay inherent in the electrical system, and for variations in running speeds of the plate being measured.

The measurement system operates on the principle of magnetic recording. There is no physical contact between the measuring system and the material being checked. In operation, an initial



pulse is applied to a recording type transducer which creates a magnetized area on the tin plate or steel strip. The strip then moves in the direction of a pickup transducer which senses this pulse. The resulting signal is shaped and then triggers an electronic counter for an initial count, simultaneously pulsing the recording transducer which creates a second magnetized area on the tin plate. This action is continuous as the tin plate passes from the recording transducer to the pickup transducer. Spacing between the magnetic transducers is fixed, so that total footage indicated on the counting device is related to this fixed spacing. The unit is calibrated to operate in the speed range of 300 to 2400 fpm (typical tin-plate line speed). **Designers for Industry Inc.**, 4241 Fulton Parkway, Cleveland 9, Ohio.

Circle 403 on Page 17

Circle 691 on Page 17→

New!

Reliance Super 'T' V*S Drives put more power, faster response and greater overload capacity into a 35% smaller package!

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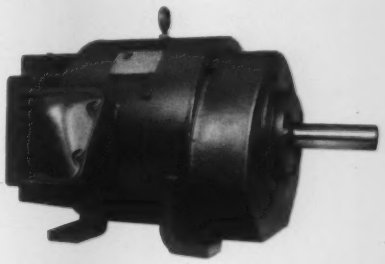
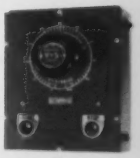
The Super 'T' V★S Drive, a complete power package, provides variable speeds from a-c. circuits



SUPER 'T' D-c. DRIVE MOTOR



OPERATOR'S PANEL

Wide range of operating speeds from a-c. circuits adds flexibility to existing production machinery. Speed changes are stepless and can be varied while equipment is operating or stopped.

Controls

New control relays, both a-c. and d-c. Field tested by three Reliance customers—for over 20 million operations without failure.*

Power Unit

Two-bearing power units are always in alignment, eliminate bearing and coupling problems.

Ventilation

Power unit cooling air is exhausted directly out of cabinet. Provides separate ventilation systems for controls and power unit. Controls are kept cooler, materially extending service life.

Insulation

Power units include new NEMA redesigned d-c. and a-c. machines. Units are smaller. Class B insulation with 60° C temperature rise allows more power in less space.

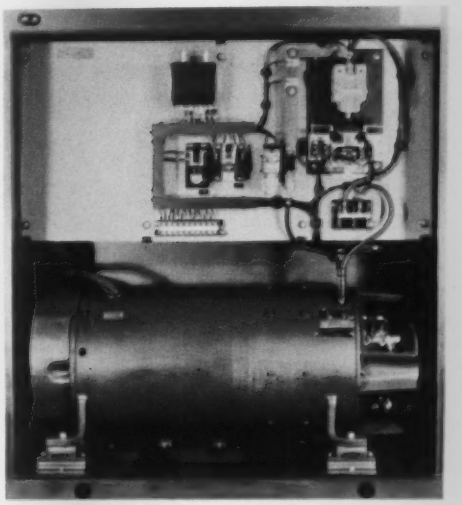
Drive Motor

Super 'T' D-c. Drive Motors give fast response to speed and load changes, take repeated 100% overloads of one minute duration without failure.

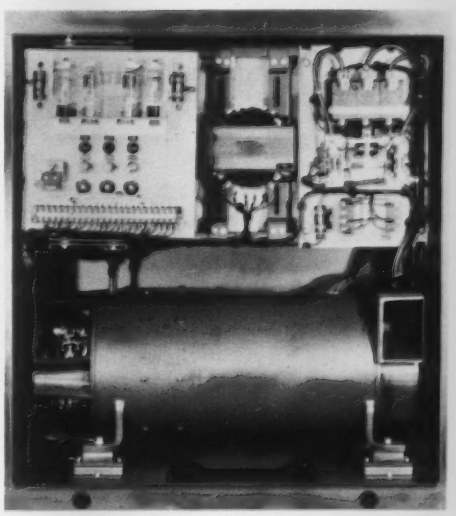
Design

Every component designed for matched performance. New motor controls, new power unit and new drive motor provide balanced operation of production machinery.

*Names on request.



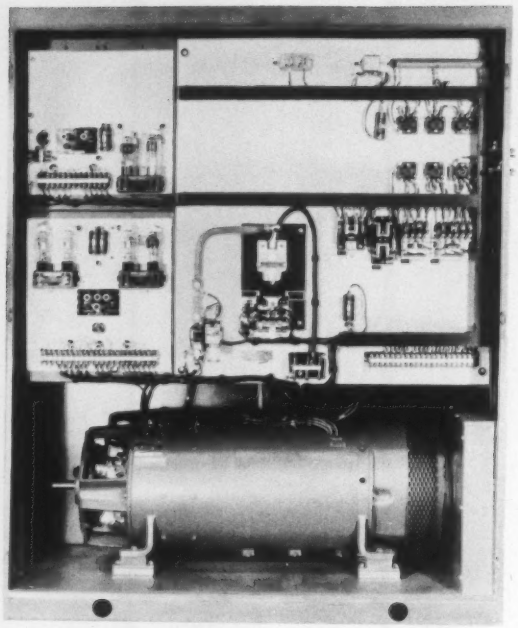
FRONT



BACK

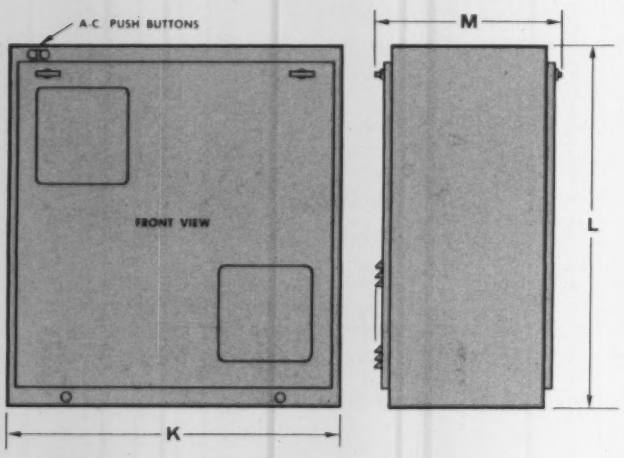
"Custom" Super 'T' V★S Drive for more flexibility, more automatic operation

Every function of the standard model and more. Custom units are designed to incorporate additional controls for engineered installations. Custom models, through the use of feed-back regulation, will provide complete system automation. Control panels are larger to accommodate controls for regulating speed, position, torque and any other operating variables.



Dimensions of Standard Super 'T' V★S Control

FLOOR MOUNTED, 1-150 V★S



Dimensions are in inches and correspond to letters shown.

V★S HP.	CABINET DESIGN	K	L	M
1-15	1SF	35	40	16
20-30	2SF	40	45	20
40-60	3SF	45	50	23
75-100	4SF	55	55	26
125-150	5SF	70	60	30

Product of the Reliance Electric and Engineering Company, manufacturers of a-c. motors, Master Gearmotors, Reeves Drives, Super 'T' D-c. Motors, generators, controls and engineered drive systems.

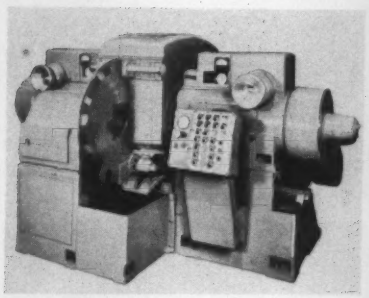
RELIANCE ELECTRIC AND ENGINEERING CO.

CLEVELAND 17, OHIO
Sales Offices and Distributors in Principal Cities
Canadian Division: Toronto, Ontario

MASTER R REEVES

RELIANCE

D-1618 Printed in U.S.A.

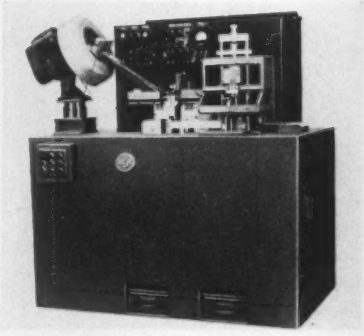


Disc Grinder

Item 404

Horizontal spindle disc grinder features automatic dressing and sizing, centralized one-shot lubrication, and a 3-step abrasive change. It is suitable for grinding parts such as bearing races, piston rings, gear blanks, valve plates, pump vanes, and clutch plates. Materials can be of steel, cast iron, nonferrous metals, carbides, ceramics, or plastics. The spindle sleeves of Model DH4 are cradled in the heads and moved by a feed screw which slides on replaceable lubricated ways. Grinding accuracy is assured by the disc and head adjustment which is constantly maintained. **Besley-Welles Corp.**, 120 Dearborn Ave., So. Beloit, Ill.

Circle 404 on Page 17

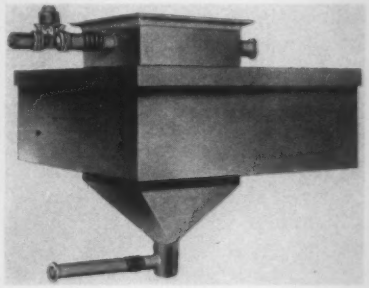


Hardness Tester

Item 405

An electronic gaging system automatically checks and classifies parts for hardness at rates up to 2500 parts per hour. In operation, parts are automatically oriented and positioned on a conveyor which carries them to a checking station. Here, they are transferred one-at-a-time to a hardness-checking penetrator. A standard minor load is applied and a clutch automatically sets the gage at zero. Then a major load is applied. The depth of penetration causes voltage changes in a gage head and these are taken off and converted to varying dc applied to standard thyratron units. The thyratrons are set to fire at upper, lower, and intermediate limits and automatically actuate segregating gates which classify the tested parts into predetermined categories after they have been discharged from the checking station. Signal lights on a control panel give a continuous indication of the entire operation. **Industrial & Automation Div., Radio Corp. of America**, 12605 Arnold Ave., Detroit 39, Mich.

Circle 405 on Page 17

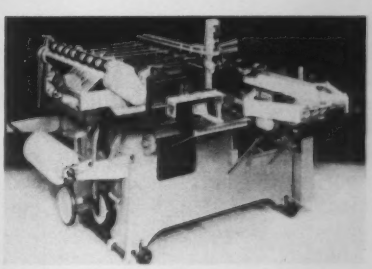


Batching Scale

Item 406

Constant-feed batching scale has an accuracy of 0.1 per cent for either wet or dry materials fed at rates of from 5 lb to 5 tons per hour. A material hopper is supported on a plate scale and the scale indicates when the hopper needs to be filled. In operation, the scale is automatically brought to zero error by a servomotor positioning a poise on the balance beam. The poise is retracted at a constant preset rate by a velocity servo system. A rotary feeder discharges the hopper at a rate dependent on the withdrawal rate of the poise. To maintain the scale in balance, a weight sensing element detects the unbalance and controls the speed of the rotary feeder. A weight register constantly indicates the weight of material in the hopper. A controlled orifice valve is used for weighing liquids. **Thayer Scale Corp.**, Thayer Park, Pembroke, Mass.

Circle 406 on Page 17

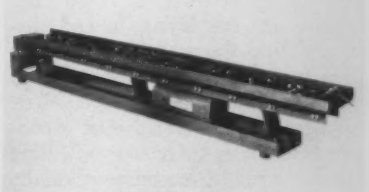


Automatic Bundler

Item 407

Items such as blankets, bed sheets, reams of paper, stacks of tablets, cookie trays, and small automotive parts can be packaged at speeds of from 1 to 18 bundles per minute. Production line outputs of 180 per minute can be accommodated when bundles are formed of dozen quantities. Wrapping material can be of polyethylene, lithographed paper with glue, glue sealing kraft, polymer-coated kraft, cellophane, heat or glue-sealing foils, or polymer-coated cellophane. With 4, 6, 8, or 12 small packages wrapped into one large bundle, bottom supports are not needed. In operation, Model 850 is set in motion any time an assembled group of products is fed into it. As each package is fed into the machine it starts a complete wrapping cycle which consists of unlocking and cutting off the sheet, forming the folds, heat sealing or gluing the folds, and discharging the finished package into a set of conveyor belts. Package sizes can be from 5 to 12 inches long, 4 to 10 inches wide and 1 to 8 inches high. **Battle Creek Packaging Machines, Inc.**, Battle Creek, Mich.

Circle 407 on Page 17



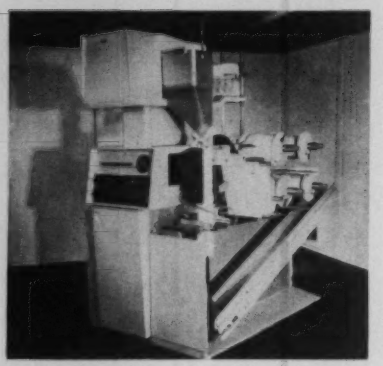
Trough Conveyor

Item 408

Tuned frequency conveyor is available in trough widths from 4 to 12 inches and section lengths of 2 feet or more. It is suitable for

screening, segregation, mixing, distribution to multiple points, orienting, and sorting. Material feed rate for Model CT-3 can be varied from zero to 40 fpm. The rating for handling sand is 10 tons per hour, with power consumption less than 200 w. Unit is designed for power sources of 115 v or 230 v or 440 v, 60 cycle current in either type 1 or 12 enclosures. **Campbell Machines Co.**, 18634 Fitzpatrick, Detroit 28, Mich.

Circle 408 on Page 17



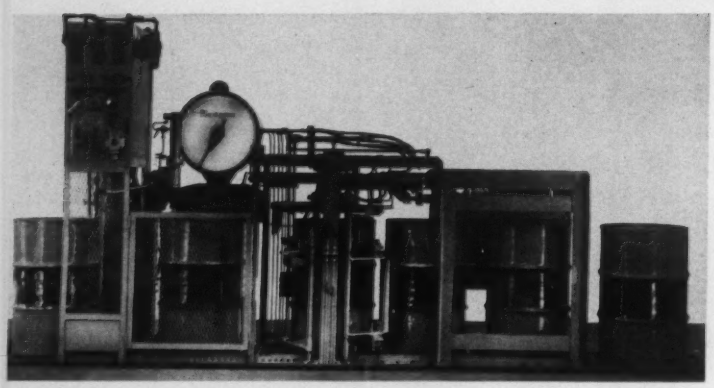
Packaging Machine

Item 409

Unit automatically forms, fills, and seals pillow-type packages at rates ranging up to 50 packages per minute. The packages can be single or double walled, made from rolls of plain or printed stock. Bags from 2½ to 8 inches in width and from 3 to 14 inches in length can be formed and filled. Heart of the operation is a weighing device, designated Hytronic. It is a temperature compensated electronic weight detector.

In operation, the material stock roll is automatically formed into a tube. The product is then net weighed by the Hytronic and discharged into the material tube. The filled tube is sealed and cut, forming a pillow-type package. The packages are discharged onto a conveyor leading to a carton-filling station. Fragile, nondimensionally controlled products such as potato chips, as well as more uniform items, can easily be handled. Controls provide instant change of sealing pressure and temperature. **Wright Machinery Co., Div., Sperry Rand Corp.**, Durham, N. C.

Circle 409 on Page 17



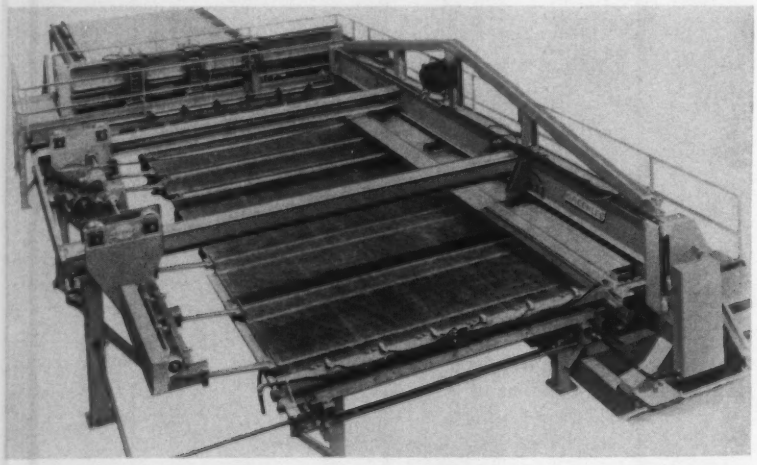
Automatic Drum Filler

Item 410

Unit can handle either 30 or 55-gallon drums, has a capacity for filling more than one thousand 55-gallon drums per eight hour shift. Filler features a tare weighing mechanism, an automatic cutoff, and a single lance mechanism raised and lowered by a hydraulic cylinder. Drum filler is a two-station machine operating on a continuous basis. In operation, as empty drums are fed to the unit by a gravity conveyor, the machine automatically locates and aligns the bung openings at the first station, then positions the drum for filling by means of hydraulically actuated rollers.

As the drum moves to the second station, the drum weight variation is automatically compensated for by the tare weighing mechanism. During the weighing operation, the filling lance automatically lowers into the drum and submerged filling begins at rates up to 275 gpm. An automatic reduction of flow a few seconds before the drum is filled prevents overfilling. Safety devices include controls which: Stop all filling operations in case of power failure; hold up operations when there is an interrupted flow of empties; stop drum filling operations if an empty enters the line upside down; and halt operations if the exit line becomes congested. **Rucker Co.**, 4720 San Pablo, Oakland, Calif.

Circle 410 on Page 17



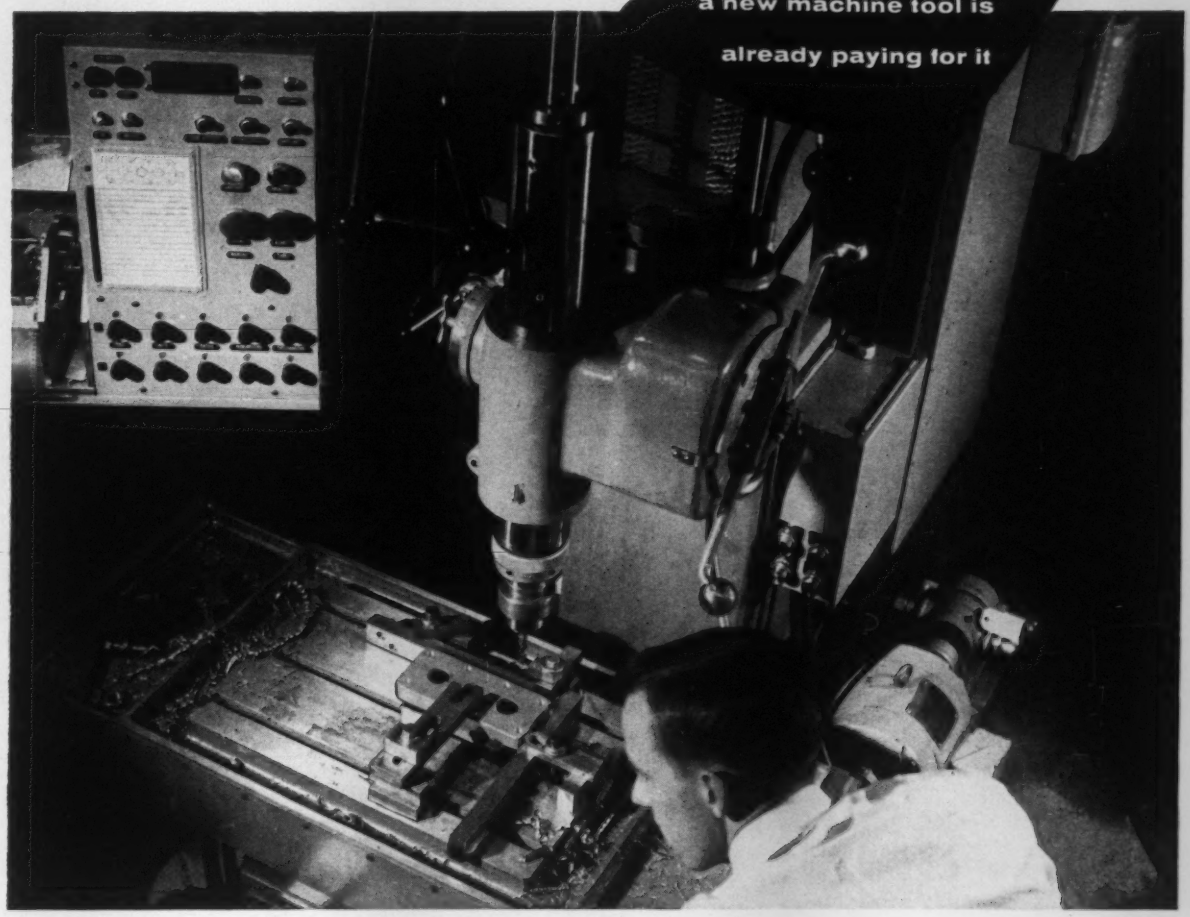
Panel Sizing Saw

Item 411

Machine automatically saws fiberboard panels as large as 13 x 25 feet into pieces of desired width and length. In operation, the pan-

JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it



Numerical control positioning eliminates jigs – saves time

The J&L Numerically Controlled Positioning Table quickly and accurately positions work pieces to an accuracy of ±.001″ — without jigs. And it can do it economically with any lot size down to a single piece.

For instance: in one installation, where precision parts previously had been machined on a conventional spacing table, J&L's new equipment achieved cycle time savings of six minutes per piece and set-up savings of over 116 minutes per set-up, or a total savings of 6.95 hours on a lot of 50 pieces.

In another plant, the cost of building $4,000 worth of jigs was eliminated during the first six weeks of operation. And in still another operation, the positioning table not only reduced set-up and cycle time, but also eliminated the storing, handling and maintenance of $29,000 worth of jigs.

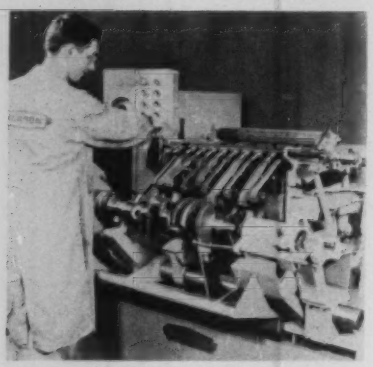
You can get in on this kind of savings too. Write to Jones & Lamson Machine Company, 536 Clinton Street, Springfield, Vermont.

Turret Lathes • Fay Automatic Lathes • Milling & Centering Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

Circle 692 on Page 17

els are ripped into strips 2 to 4 feet wide. Feed chain beams transport the panel through the saws. Then the 25 foot long strips are automatically fed by a reciprocating pusher mechanism through a set of saws which are set at right angles to the first pair. These saws reduce the strips to panels of desired length. Each cutting unit is powered by a separate motor and all adjustments are made from overhead catwalks. **Greenlee Bros. & Co.**, 2136 Twelfth St., Rockford, Ill.

Circle 411 on Page 17



Crankshaft Lapper

Item 412

Machine produces fine surface finishes by means of coated abrasive strips; can be adapted to automatic work loading and unloading devices to provide completely automatic operation. Model 31 laps pins and bearings simultaneously to low micro-inch readings. It is designed for automotive type crankshafts and can also be used for other types of parts. The head and foot stocks are carried on a swing frame mechanism which swings out at hand high level to the operator. After the part is placed in vee-blocks between the head and foot stock, the operator pushes a *Start* button and the automatic cycle begins. Because the swing-frame mounted head and footstock bring the work to the lapping arms, parts have to be held in position for loading only. The lapping arms clamp on the surfaces to be lapped and when the crankshaft is rotated, the arms follow the motion of the surfaces. **Norton Co.**, Worcester 6, Mass.

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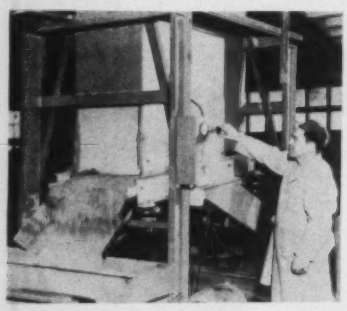


Vibrating Feeder

Item 413

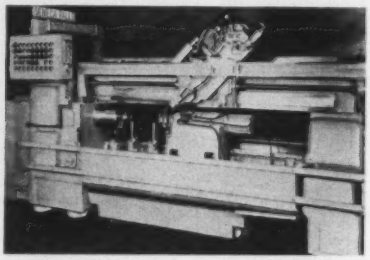
A feature of the mechanical vibrating feeder is the pneumatic control system. Main components in the feeder are a stepless amplitude control and a natural-frequency drive. The drive unit has a 900 rpm, ac motor-exciter mounted between two banks of heavy-duty, industrial air springs. In operation, the motor running at a constant speed rotates exciter weights. These weights generate a concentrated centrifugal force against the springs. Stabilizers restrict the motor-exciter unit to straight line, back-and-forth vibrations against the two banks of air springs. At natural frequency the springs amplify this force into uniform vibrations that drive the feed trough. If required, the spring stiffness can be changed during operations. The feeders require only a 50 psi plant air supply system. A standard control panel for both air and power supply is provided. The control can be local or remote, manual or automatic and it will respond to any standard process instrumentation. Pressure in the springs is indicated by a pressure gage and adjusted by an air valve. The electric motor is controlled by a magnetic starter and a *Start-Stop* pushbutton station on the control panel. A safety feature is an automatic low pressure motor cut off switch. **Carrier Conveyor Corp.**, 211 N. Jackson St., Louisville, Ky.

Circle 413 on Page 17

Automatic Lathe

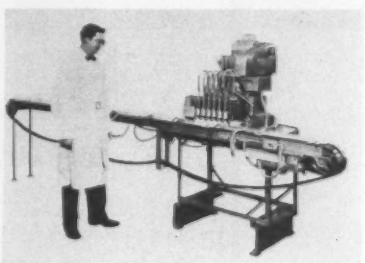
Item 414

Automatic lathe features a dial system which provides automatic sequencing of rough and finish passes without removing the workpiece from between centers. The carriage travel and diameter of cut for each pass of a tracer carriage are controlled by the dials which are mounted on the machine. A start position, end cut, and specific diameter are set on dials for each pass. The machine can automatically sequence through as many as nine roughing and semifinish passes before proceeding automatically to the finish cut. Only one template, manufactured to the finished dimension of the workpiece, is required.



The tracing mechanism consists of a stylus, electric amplifier, mechanical power amplifier for positioning cross slide, and a master template. Mechanical movement of the stylus as it follows the template creates an output voltage within the stylus housing. This voltage is amplified and controls speed and torque of a low power servo motor. The mechanical amplifier reproduces and magnifies the torque-speed variations and transmits exact stylus motion to the tracer tool slide. **Seneca Falls Machine Co.**, Seneca Falls, N. Y.

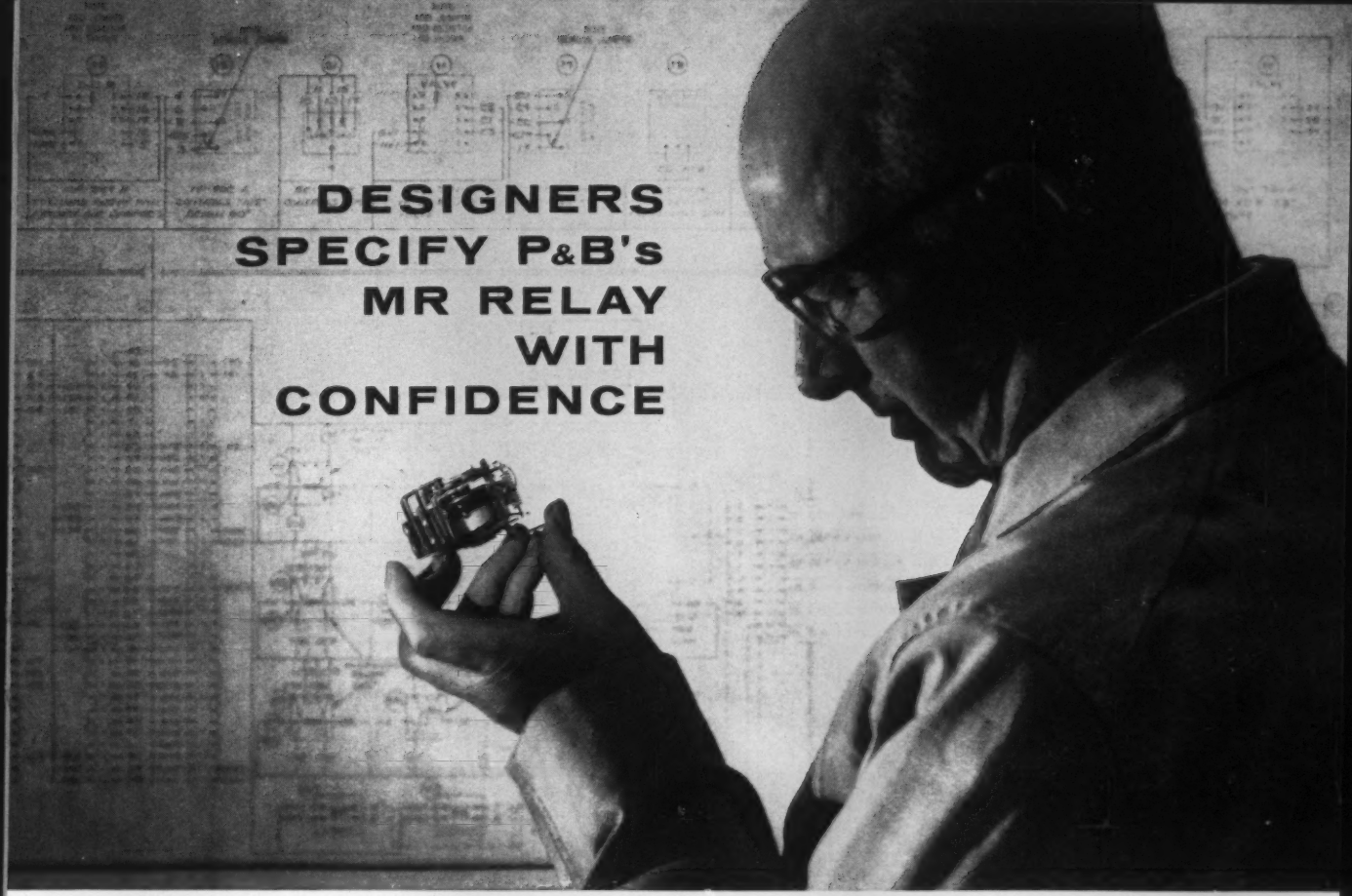
Circle 414 on Page 17



Liquid Filler

Item 415

Glass, plastic, or metal containers can be filled by machine which has a plunging and centering nozzle design. Unit includes an air-operated escapement; a bottle conveyor; and a multiple nozzle liquid filler with metering cylinder and valve assemblies which maintain filling



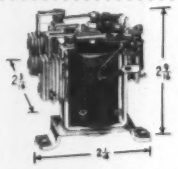
for a host of control applications

RELIABILITY coupled with low cost are two factors which place the MR series relays high on P&B's best seller list. They are being used in a multiplicity of designs . . . transmitters, street lighting equipment and small motor starters, to name but a few.

Both AC and DC models are available, with AC coils ranging up to 440 volts. All are adaptable for printed circuit mounting. The wide variety of contact arrangements include:

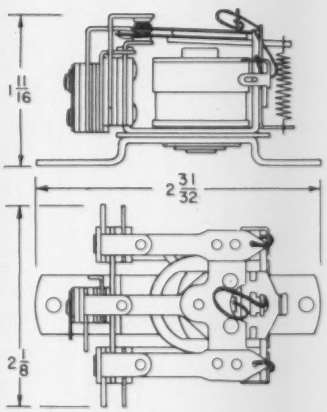
SPST-NO	SPST-NC-DB	DPST-NC	3PST-NC
SPST-NC	SPDT	DPDT	3PDT
SPST-NO-DB	DPST-NO	3PST-NO	

For more information about this medium duty, compact relay, call or write today—or get in touch with the P&B sales engineer nearest you. See our complete catalog in Sweet's Product Design File.



LM SERIES: Plate circuit relays similar to the MR. All sp and dp contact arrangements shown above are available. Coils are wound to specified resistances up to 58,000 ohms max. Sensitivity ranges from 15 mw min. (single pole) to 70 mw min. (double pole).

MR SERIES



GENERAL SPECIFICATIONS:

Breakdown: 1500 volts, 60 cycle rms between all elements.

Temperature Range:
DC —55°C. to +85°C.
AC —55°C. to +75°C.

Pull-in: Approx. 75% of nominal dc voltage; 78% of nominal ac voltage.

Weight: 4 ozs.

Dimensions: 2 31/32" long x 2 3/16" wide x 2" high.

Mounting: Two 9/32" dia. holes. Can be adapted for printed circuits.

CONTACTS:

Arrangements: Up to 3pdt.

Material: 7/32" dia. silver. (Others available).

Load: 8 amps @ 115 volts, 60 cycle, resistive.

COIL:

Max. Resistance: 34,500 ohms.

Power: 1.5 watts dc; 3.25 volt-amps ac. Will withstand up to 6 watts at 25°C.

Voltages: Up to 110 volts dc; up to 440 volts 60 cycle ac.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD INC.

PRINCETON, INDIANA • SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

IN CANADA: POTTER & BRUMFIELD CANADA, LTD., GUELPH, ONTARIO

Circle 693 on Page 17

accuracy within one per cent on each fill. Drip-free filling is provided by an adjustable control on the metering cylinder and by positive centering of the container for the plunge-filling operation.

A spring-loaded plastic aligner is mounted on each nozzle. This contacts the container as the nozzle assembly is lowered by a drum cam mechanism driven from the filler motor drive. Further downward travel of the nozzle assembly causes the nozzles to enter the container for the filling operation. Centering of the containers for the filling operation is independent of size variation in the containers themselves. Model 106A can fill as many as six bottles simultaneously. Models in line have fill rates from 40 to 480 containers per minute. **Arthur Colton Co.**, 3400 E. Lafayette, Detroit 7, Mich.

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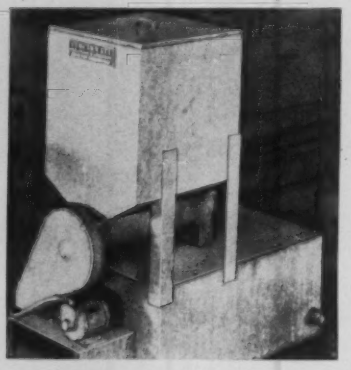

Solution Makeup Device

Item 416

Applicable to any equipment with solution tanks, unit is designed to automatically maintain tank solution level and strength. It feeds and mixes dry chemicals into water. If the chemicals are not readily soluble, an electrical tank agitator can be furnished to properly mix the two. In operation, when the controlled solution tank level drops, a float valve actuates a screw conveyor which accurately feeds dry chemicals from a hopper. Simultaneously, a solenoid valve furnishes fresh water at the rate required for the proper solution strength. **Cincinnati Cleaning & Finishing Machinery Co.**, 2030 Hageman St., Cincinnati 41, Ohio.

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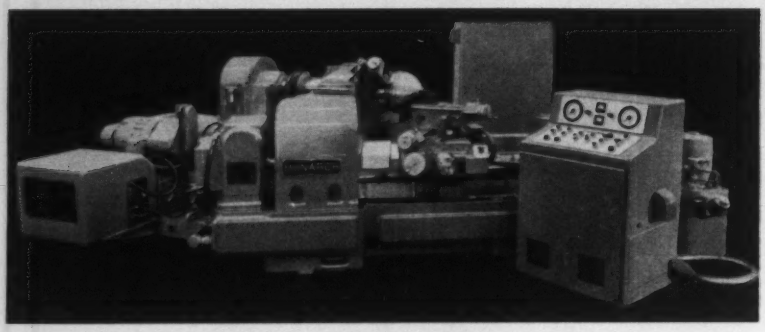
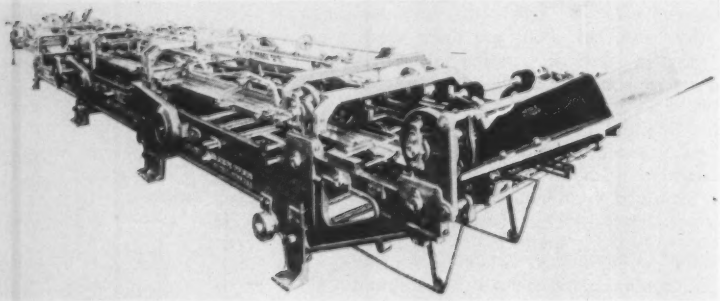


Chucking Type Contouring Lathe

Item 417

Lathe is designed for the OD and ID machining of thin wall spherical and related shape workpieces. Diameter range which can be contoured is 5 to 15 inches. Total speed range is 8½ to 1000 rpm, with a constant surface cutting speed over a 6:1 ratio. The spindle is set at a 30 degree horizontal angle to the bed axis; runout at the nose is less than 25 millionths of an inch. Spindle bearing lubricant is refrigerated. The lathe is mounted on a cast base, with an infinitely variable dc drive coupled to the spindle by a flexible coupling, eliminating vibration transmittal from the drive to the bed. The cross slide moves on preloaded steel balls. Two tool adjusting slides permit tool adjustment both parallel to and at right angles to the spindle axis. An electrohydraulic tracing system controls slide position while tracing around a template. The tracer head is mounted directly on the tracer slide, while the template table is located below the carriage between the bed ways. Carriage feed is powered by a separate, infinitely variable motor drive through a multiple feed range gearbox. Complete feed range is from 0.008 to 7.5 ipm. **Monarch Machine Tool Co.**, Sidney, Ohio.

Circle 417 on Page 17



Carton Gluer

Item 418

Gluing machine can handle carton blanks ranging in size from 4 by 6¾ inches to 28 by 40 inches; production rate is up to 350 cartons per minute. Features of Model MD include: An adjustable split feed wheel, a 360 degree adjustment to the upper feed shaft and a 360 degree adjustment between the main drive and the timing section. Unit also has antibacklash gearing, modified side guides, antifriction bearings, and flange couplings. **E. G. Staude Mfg. Co., Inc.**, 2675 University Ave., St. Paul 14, Minn.

Circle 418 on Page 17

Plate Embosser

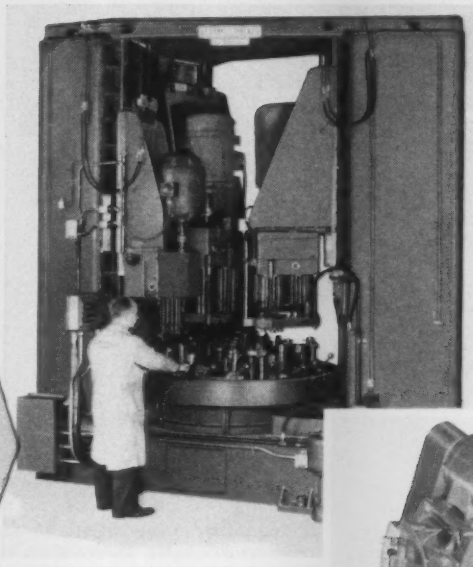
Item 419

An automatic line and character indicator, quick-change line and

KEARNEY & TRECKER *builds production*

MACHINE TOOLS FOR EVERY INDUSTRY

Since 1898 . . . Kearney & Trecker Customer Engineering Service — supported by an outstanding staff of engineers experienced in production milling machine design and application — combined with the finest and latest machine tools in an ultra modern plant is always ready to solve your production problems.

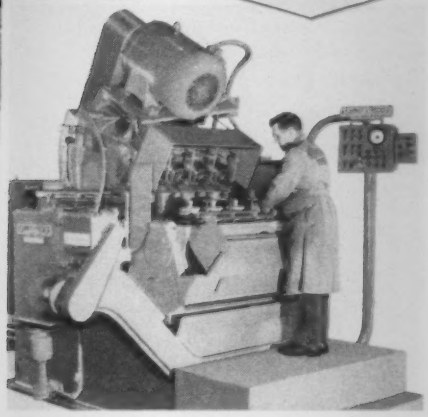


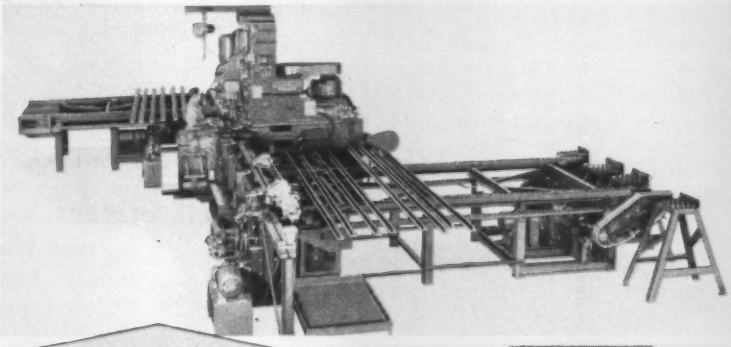
Automotive Industry

this 88 spindle, 3 vertical head machine performs drilling, chamfering, counterboring, trepanning, spot-facing, reaming and tapping operation on a differention case and cover. PRODUCTION — 67 cases, 67 covers per hour.

Oil Industry

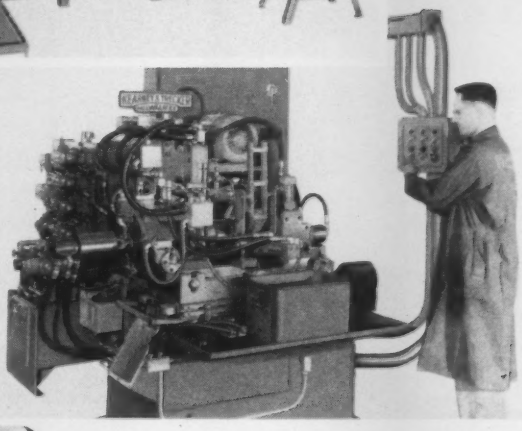
automatic 4-spindle milling machine mills 4 rock bit cones *simultaneously*... in a trunnion-type fixture having 4 work-piece spindles. PRODUCTION — a constant flow of this expendable type tool to meet the steady demand.





Elevator Industry

12 spindle automatic transfer machine mills mating tongue and groove on ends of elevator guide rail-drills mounting holes in rail flanges—for continuous rail mounting. PRODUCTION—28 completely machined rails per hour—180% increase over old method.



Tool Industry

Flutes and shank squares are milled on tap blanks by this automatic machine. Tap blanks are hopper loaded and automatically unloaded. RESULT—greatly increased hourly production.

KEARNEY & TRECKER MILWAUKEE ®

Write for bulletin SMD-57 on your company letterhead.

KEARNEY & TRECKER CORPORATION

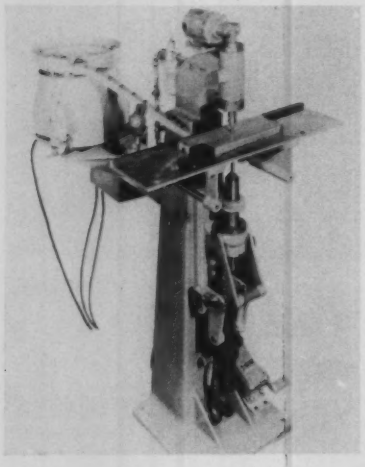
Special Machinery Division

6784 W. National Avenue • Milwaukee 14, Wisconsin

Circle 694 on Page 17

character spacing controls, automatic plate positioning, and selective line and character spacing are features of Model 6400 which produces embossed metal plates or plastic credit and identification cards. Keyboard of the machine has a carriage release key, electric shift and back space key, and an automatic tabulation key. The cabinet has a copy holder, copy indicator, and a fluorescent lamp. **Addressograph-Multigraph Corp.**, 1200 Babbitt Rd., Cleveland, Ohio.

Circle 419 on Page 17



Spin Riveter

Item 420

Unit is capable of spin riveting turret terminals into punched or drilled terminal boards. The hopper is designed to feed the terminals underneath the worktable. The initial pressure on a double-action foot controller raises the anvil and places a terminal into a hole in the board selected by an operator. Increased pressure on the foot control brings down a spinning, air-operated peen. Impact, position, and speed of anvil, and the number of blows are controlled automatically. Once the different elements are adjusted, the machine will provide uniform riveting on every terminal. **Hill Machine Co.**, 1311 Eddy Ave., Rockford, Ill.

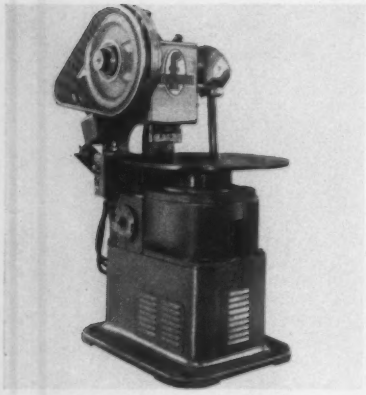
Circle 420 on Page 17

Parts Feeder/Orientor

Item 421

Purpose of device is to feed and orient headed or slightly tapered parts. Design of the roll feeder permits the part to be fed with no rejects, regardless of position at discharge. It can also be used to inspect parts by discarding or dropping undersized parts. A photoelectric control keeps the hopper supplied with parts, but will not overload it. The delivery rate can be easily adjusted to the application. **Peeco Div., Automation Devices Inc.**, Erie, Pa.

Circle 421 on Page 17



Rotary Assembly Unit

Item 422

Device features an integral pressing station which is capable of performing crimping, riveting, staking, and forming operations in conjunction with automatic assembly. It is also suitable for dial fed secondary press functions in the manufacture of small parts. Capacity of the press station is 14 tons with a 2-inch stroke. Machine has a roller gear drive as the dial indexing mechanism; provides a smooth transfer without sudden starts and stops. Drive has an accuracy of 0.001-inch and zero backlash without auxiliary locating or locking methods. Frame design permits easy access to press bearings, pitman, slide, or die from behind the press. A single motor drives both press and indexer. Unit is available in two models with dial sizes of either 24 or 36 inches and 6, 8, 12, or 16 stations. **Roller Gear Div., Ferguson Machine Corp.**, 7818 Maplewood Industrial Court, St. Louis 17, Mo.

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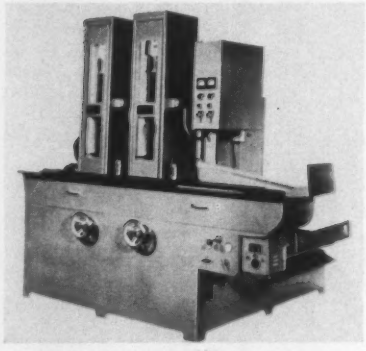


Abrasive Belt Grinder

Item 423

Multiple-head, abrasive belt grinder can perform two or more grinding and finishing operations at the same time. Unmachined surfaces, ground on a series of progressively finer-grit abrasive belts, can be finished to a fine polish to exacting tolerances in one continuous pass. More than one belt of a given coarseness can be used to increase production rates. Model 696 has grinding heads which are equipped with tapered, hardened, precision-ground spindles mounted in roller bearings. Conveyor belt that feeds work has an infinitely adjustable feed rate of from zero to 67 fpm. Speed of the abrasive belt is 5400 sfpm. Machine drive motor is 7½ hp, 3600 rpm, with 10 or 15 hp optional. **Engelberg Inc.**, 831 W. Fayette St., Syracuse 4, N. Y.

Circle 423 on Page 17

Robo-Lift's "tender touch" works for General Mills

Robo-Lift provides its gentle action to operators of General Mills. This bucket elevating conveyor can be depended on not to crumble cereals, not to make cake mixes lumpy.

Some of the 20 Robo-Lifts at General Mills' Toledo Plant feed raw materials into processing machines. Others carry finished products to packaging operations. Robo-Lift's versatile "up-and-over" operation is especially welcome in this one-floor plant where second-story top-loading is impossible.

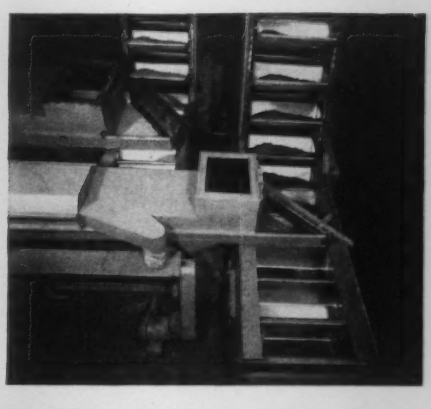
Stainless steel buckets make Robo-Lift ideal for all food processing plants. They are easy to keep clean, help keep products pure. Overlapping edges prevent spilling—ease housekeeping problems.

Robo-Lift will provide gentle, sanitary, economical materials handling for your plant. Its "tender touch" will help keep your product quality high. Write for complete details.

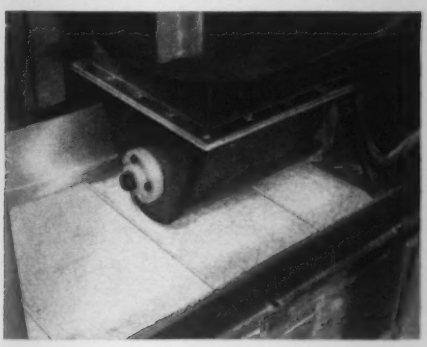
Send for the six page folder
that tells the complete story
of Lynch at General Mills.

LYNCH CORPORATION
Anderson, Indiana
Manufacturing Engineers of
automatic processing equipment
for the glass, packaging, plastic
and other industries

Atlanta • Chicago • Wallington, N.J. • Kansas City, Kansas • San Francisco



Filling Robo-Lift with dry cereal from drying trays and vibratory feeders. Robo-Lift carries cereal to sugar-coating process or to package-filling point.

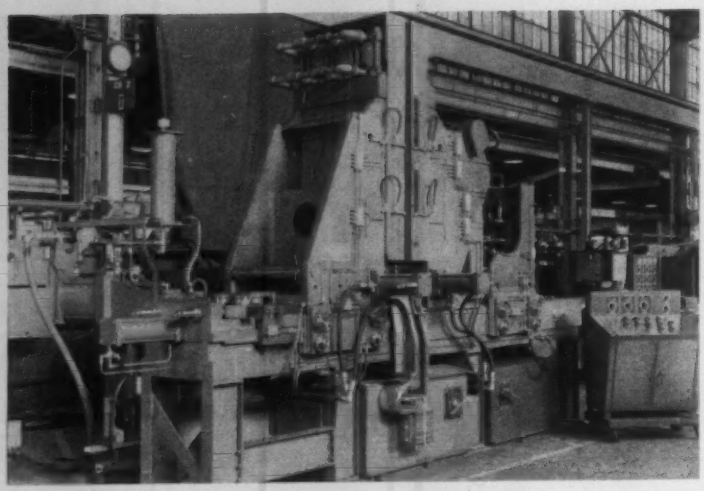


Robo-Lift carries General Mills cake mixes from the mixing operation to the packaging point. The machine's gentle action prevents chunkiness—assures a smooth, uniform mix.

Among the many General Mills products handled by Robo-Lift are Cheerios, Coco Puffs, Kix, Trix, Hi-Pro, and 25 different cake mixes.

LYNCH
CORPORATION
Anderson, Indiana

Circle 695 on Page 17



Flash-Butt Type Welder

Item 424

Unit is designed for the flash-butt welding of hot rolled, low carbon steel ranging from 0.060 to 0.200-inch in thickness and from 12 to 22 inches in width. It is suitable for use in various mill and process functions where a continuous feed of strip stock is required. In addition to the welding operation, the machine also shears off flash particles, maintaining a flush surface.

In operation, the strip movement is from left to right. The strips are located against a gaging bar with their edges aligned. Then they are clamped. After clamping, the gaging bar is retracted from between the ends of the strips. When a pushbutton is actuated, the welding operation begins. A flashing cam advances the right-hand platen to close the gap between the strip ends. This starts the flashing action. During the flashing time, a high current at low voltage causes the strip ends to glow and reach a plastic state. An upsetting action then forces and fuses the ends together. After the upsetting operation and an adjustable hold time, the clamps are released and lift rollers raise the strip above the level of the lower dies. The platen returns to its initial position and the welded strip passes through the welder to a plow shear where the flash particles are removed. A pushbutton actuates the gaging bar and brings it into position for the next operation. The upset force is adjustable to a maximum of 90,000 lb and the clamping force is adjustable to a maximum of 135,000 lb. Maximum platen opening is 8 inches. The welding current is provided by air-cooled welding transformers rated at 400 kva at 50 per cent duty cycle. **Sciaky Bros. Inc.**, Dept. M-21, 4915 W. 67th St., Chicago 38, Ill.

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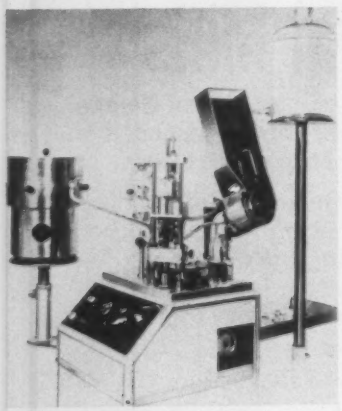

Vial Filler/Capper

Item 425

Packaging machine is capable of feeding, capping, and sealing small bottles and vials. In operation, bottles are fed from a magazine to a rotary feeder at synchronized speeds. The liquid filling process is accomplished without air bubbles in two steps. The first time approximately 50 per cent of the bottle is filled and the second time filling is completed. At this time all the air is forced out and kept out by a nonreturn valve. The sealing operation is performed by a spinning mechanism which has an adjustable piston and spinner pressure. The seals are sorted and fed from a vibrator through a feed slide and positoned on the containers. An outlet tube delivers the sealed bottles to a conveyor for subsequent packing and shipping. Production rate is up to 3600 units per hour. **Arenco Machine Co. Inc.**, 25 W. 43rd St., New York 36, N. Y.

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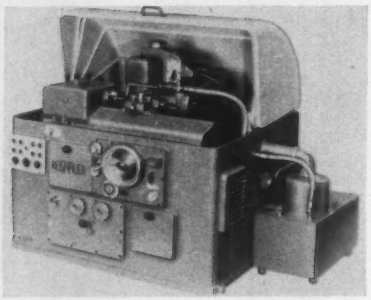


Thread Grinding Machine

Item 426

Automatic unit provides precision thread grinding on small workpieces such as taps with straight and helical flutes, micrometer spindles, thread gages, and small worms with fine pitches. Reprofiling of the grinding wheel occurs during the return stroke of the table slide, with a choice of three different reprofiling speeds. Frequency of reprofiling can be set to occur after 1, 2, 3, 4, or 6 strokes. Machine has an automatic, electric truing device with two easily adjusted dressing heads which operate independently and simultaneously. Another electric truing device available has one dressing head in which one diamond tool oscillates along both flanks and can describe a radius. **Cosa Corp.**, 405 Lexington Ave., New York 17, N. Y.

Circle 426 on Page 17

Rotary Parts Feeder

Item 427

Continuous, controlled flow of up to 20,000 oriented parts per hour is possible with rotary parts feeder. Orientation of parts is performed on a feed track which can be ad-

Louden Selectomatic Handling is

AUTOMATIC

Materials Handling

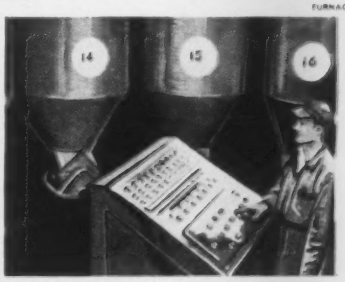
Time after time, overhead materials handling proves to have many advantages over any other type. When coupled with Louden's exclusive Selectomatic Control, such a transport system approaches the ultimate in economy by being virtually *automatic*.

Its use by a leading glass manufacturer provides a good example. Here a distribution system of Louden TrojanTrack monorail, controlled by Louden Selectomatic, is in operation 24 hours a day. At the touch of a button, a gross live load of 33 tons is on its way . . . transporting its load of mix to a designated furnace automatically. Carrying thousands of tons of material daily, this system endures hard and heavy service with a minimum of maintenance attention.

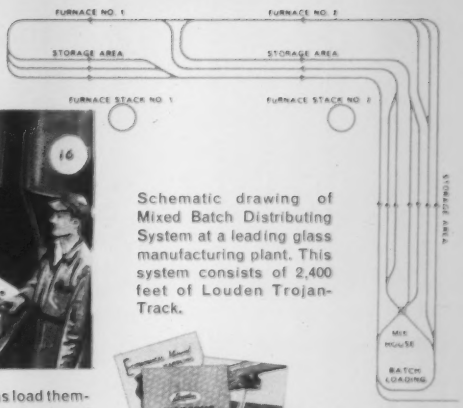
This is just one of the many handling problems that have been solved with Louden Monorail. No other handling system permits such a wide diversity of uses. Over one universal handling system, easily installed and easily enlarged as occasion demands, your product can be handled from raw material to the wrapped package without one interruption to the smooth, even flow of production. Handling never becomes rehandling with Monorail.

Louden Automatic Materials Handling is the guaranteed product of the pioneers and oldest company in the field of specialized monorail handling. Both the Louden field representatives and the factory engineers are highly trained specialists in the field of overhead materials handling. When you have a materials handling problem or any plant problem involving lifting and transporting loads, call on Louden for suggestions. Your inquiry will receive prompt attention.

Storage area of Mixed Batch Distributing System at a leading glass manufacturing plant. Operating over the system are 29 Louden Selectomatic Moto-Veyor propelled trains of 6 batch cars per train.



Operator dispatching train. Trains load themselves, transport the load, store the load until needed, and then unload at the designated furnace all automatically.



Schematic drawing of Mixed Batch Distributing System at a leading glass manufacturing plant. This system consists of 2,400 feet of Louden TrojanTrack.

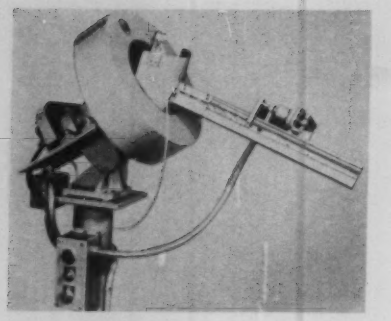
Get the latest information on the best in modern materials handling systems. Write today for your copy of "Economical Material Handling", a 52-page book full of how-to-do-it ideas. If you are interested in automation, ask for the new book on Louden Automatic Dispatch, "Automatic Materials Handling". With either you will receive the latest information on Louden Shok-Pruf Electrification, new safety in power for cranes and monorail systems.

THE LOUDEN MACHINERY COMPANY
9605 Broadway, Fairfield, Iowa
A Subsidiary of Mechanical Handling Systems Inc.

Louden
MONORAIL & CRANES

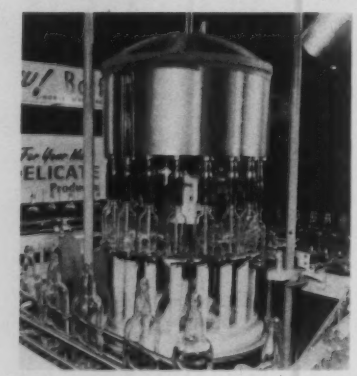
SINCE 1867 . . . THE FIRST NAME IN MATERIALS HANDLING

Circle 696 on Page 17



justed or changed in less than a minute. Standard tracks are available for a variety of part shapes. In operation, parts are lifted from the bottom of a bowl by hardened cleats on a selector ring and deposited on an inclined discharge track as the hopper rotates. As the parts slide down the track, they are oriented and directed to the machine being fed. Excess and unoriented parts slide back into the bowl. Feeder has a standard gear-head motor, a cast-iron frame, and a driving mechanism supported by heavy-duty self-aligning bearings. **Industrial Automation Equipment, Radio Corp. of America,** 13541 Auburn Ave., Detroit 23, Mich.

Circle 427 on Page 17



Under-Surface Filler

Item 428

Designed for handling foamy liquid products, machine features a double action valve. At the start of the fill, the double action valve drops a filling tube to the bottom of the container and then withdraws the tube gradually, so that the entering liquid is always below the surface of the liquid. This method is said to minimize the formation of foam and incorporation of air into the product. Model HB-BF-9 can handle gallon or ½ gallon bottles. The filling mechanism is built into a conventional filler and the unit can be used as a standard gravity filler if needed. **Horix Mfg. Co.,** Corliss Station, Pittsburgh 4, Pa.

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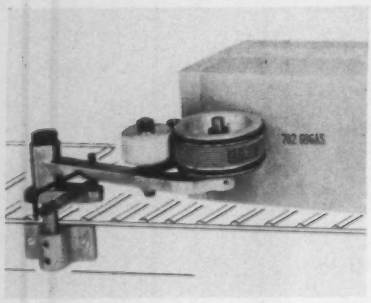

Roll Marker

Item 429

Device is suitable for imprinting changeable data such as codes, dating, and trademarks on items such as cartons, bags, rolls, cans, and drums. The marker, designated Rocket, is friction operated and self inking. It can be converted readily from a printing height of 1 inch to up to 2 inches. Base-lock rubber type is easily set up and changed. More than one unit can be used to simultaneously mark both top and sides or 2 sides. **Pryor Marking Products,** 434 S. Wabash Ave., Chicago 5, Ill.

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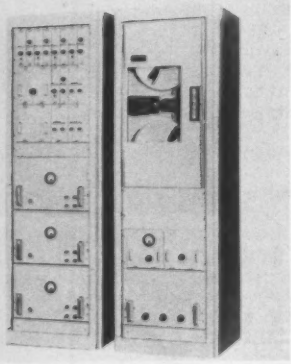

Magnetic Recorders

Item 430

Instrument can simultaneously record seven channels of video data —each of which requires one megacycle bandwidth. This can be accomplished for a 15-minute period on one reel of ½-inch wide tape. Changes can be made quickly in the field to convert the basic transport mechanism from frequency modulated data system usage to either pulse modulated or direct analog recording service. The recorder will also store and later reproduce the various types of signals when required. **Mincom Div., Minnesota Mining & Mfg. Co.,** 2049 S. Barrington Ave., Los Angeles 25, Calif.

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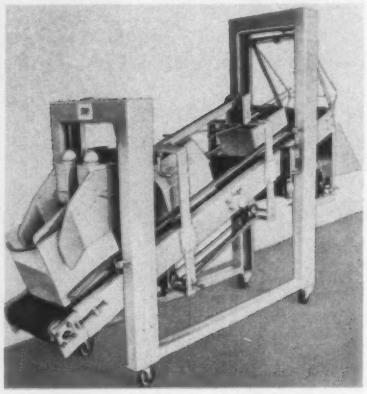


Portable Case Sealer

Item 431

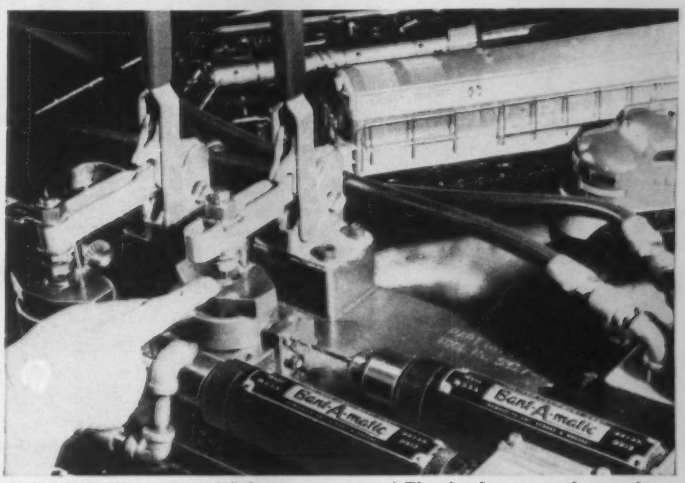
Device is designed to turn filled cases upside down to let the weight of contents of each case compress its glued top. Setting of the glue occurs as the case is transported on conveyors or stored on pallets. Case sealer can handle a range of case sizes up to 16 inches wide, 20 inches long, and 12 inches high. It is mounted on casters and can be rolled from one case loading operation to another.

In operation, filled cases are delivered to the case sealer on a conveyor. The cases move up an incline on a corrugated belt. Flaps are automatically tucked in and skip-glued, then the top flaps are folded down onto the glued surfaces. As the case reaches the top of the incline, it is turned upside down onto a slide which delivers it to a pallet or conveyor. **Standard Metal Products Co.,** 123 N. Racine Ave., Chicago 7, Ill.

Circle 431 on Page 17

Your Choice!

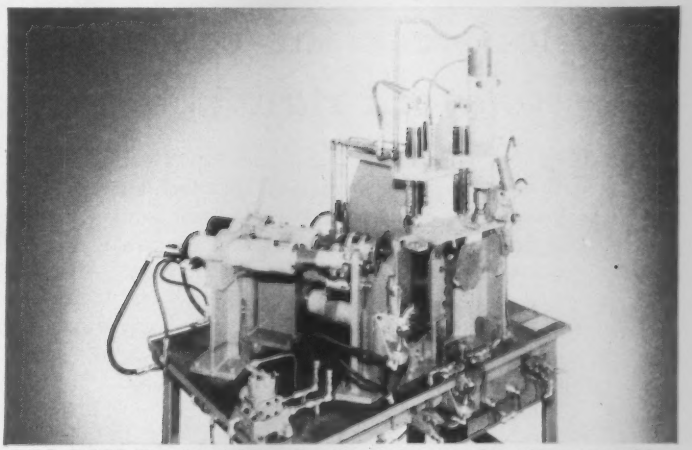
COMPONENTS
You do it!



YOU DO IT—using ARO components! That's the way the makers of Lionel trains automated drilling. They used ARO Bant-A-matics and accessories . . . installed by their own plant men.

OR

COMPLETE PACKAGE
ARO does it!



ARO DOES IT—furnishing the "complete package"—everything from engineering to installation. That's how ARO Automation solved this problem for a maker of automotive parts.

DRILL, TAP, FASTEN *faster* **with**

ARO

AUTOMATION AIR TOOLS

Name your problem in drilling, tapping or fastening . . . ARO can show you a simple way to solve it and step up production!

SINGLE OR MULTIPLE SET-UPS . . . air operated units for widest range of applications. Choice of 4 sizes. Capacities up to ¾". Minimum center to center distance 1".

ARO offers as much help as you need—from components to "complete package" including engineering, fixtures, accessories, automation tools and installation.

Let ARO Automation solve your problems in drilling, tapping, fastening. WRITE or call Aro for the help you need—or contact your Aro Field Representative.

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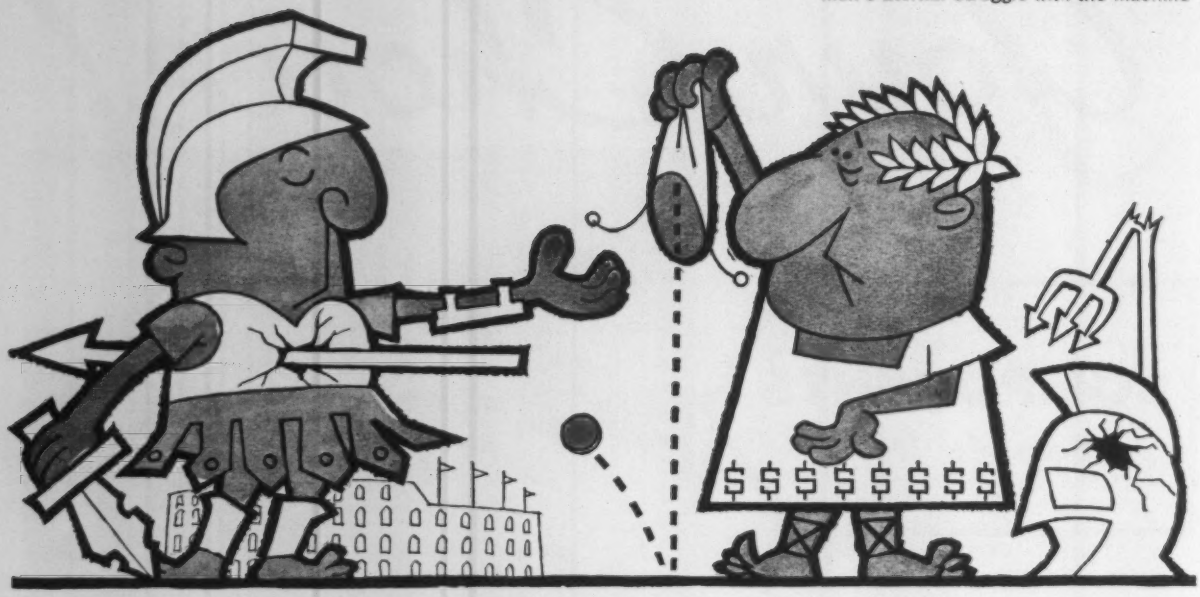
ARO ® **AIR TOOLS**
Also Portable Air Tools...
Air Hoists...Air Motors

Circle 697 on Page 17

Man's Eternal Struggle with the Machine



WITH ALL THE COSTS OF DOING BUSINESS RISING STEADILY, PROFIT IS MORE ELUSIVE THAN EVER!

How long can the cost of "getting new equipment to work right" be buried in overhead?

No matter how attractive the original price of the equipment, it's false economy if the price tag *did not* itemize the extra money required to get it into production!

To your great responsibility for improving manufacturing processes has been added an *extra* concern for that old standby, catch-all type goodfellow called "overhead".

Overhead can no longer afford the labor and hard, cold cash-money often needed to make new equipment operate properly.

Sciaky knows about "overhead", too. That's why Sciaky resistance welding and production equipment is built to satisfy the requirements of *your* particular application. That's why Sciaky equipment is thoroughly tested and proved to do that particular job *before shipment.*

The result protects the profit your manufacturing operations can earn by (1) providing only the right equipment at the right price, (2) minimizing the lost time and cost of production try-out, and (3) minimizing rejects and costly re-working.

Why take less than the full advantage of consulting with a Sciaky Application Engineer the next time you are considering equipment. No obligation, of course.

A successful manufacturer of double-bowl kitchen sinks took that advantage. As a result, they replaced the previous high-reject, unprofitable method of fabrication with Sciaky resistance welding equipment. Within only ten days of installation, over 10,000 sink units were produced with less than a 1% scrap factor. Write for "Resistance Welding At Work", Volume 4-No. 6 for the details.

SCIAKY

68A

SCIAKY BROS., INC., 4942 W. 67th STREET, CHICAGO 38, ILLINOIS • POrtsmouth 7-5600

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 17.

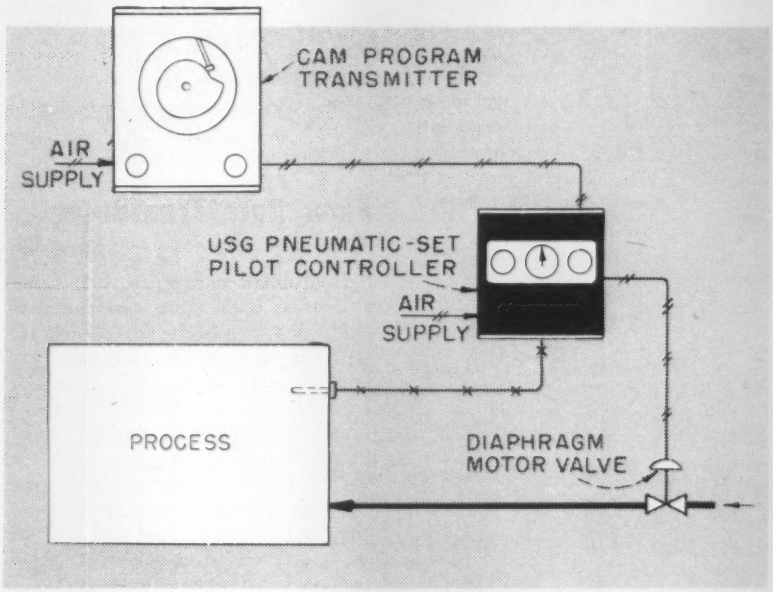


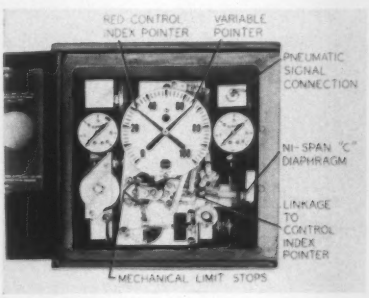
Diagram shows the typical use of a pneumatic-set indicating controller in a programmed control system.

Pneumatic Indicating Controller

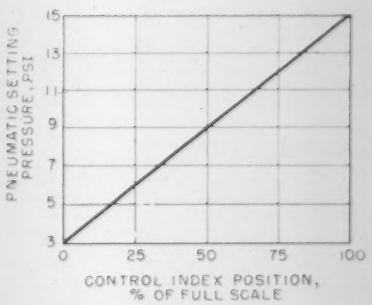
LINE of indicating controllers is available with measuring elements for temperature, pressure, liquid level, or flow with various types of pneumatic control action. Set point of the controller can be positioned by a 3 to 15 psi pneumatic signal. A diaphragm stack converts the pneumatic set signal into mechanical motion. Through a linkage, this motion drives the control index to a position proportional to the signal. Pilot controller was designed by **U. S. Gauge Div., American Machine & Metals Inc.**, Sellersville, Pa. When the controller is remotely located, the set point can be adjusted from a centralized control panel by means of a manual pneumatic loading station. When the process characteristics require cascade control, a primary controller pneumatically adjusts the set point of a secondary controller. The maximum and minimum travel of the control index can be preset by means of a screw-adjusted mechanical stop. With the same adjustment, the pneumatic setting signal can be overridden to position the control index manually at any point of the scale.

Cascade Control System

In an application example of the cascade control system, the primary controller measures the temperature of fluid being heated in a heat exchanger. This fluid temperature is controlled by the throttling of steam supplied to the exchanger coils. The large time lag, between the change in heat input and its effect on the temperature, is such that the output of the temperature controller is used to adjust the set point of the steam pressure con-



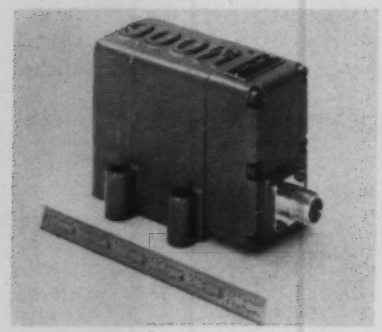
Close-up view of the controller. Device contains red control index pointer, variable pointer, pneumatic signal connection, and mechanical limit stops.



Graph shows linear relationship between pneumatic signal pressure and control index.

troller. This results in a closer and more stable control. The controller can also be used with a cam program transmitter, so that a signal is sent to the controller in accordance with a predetermined schedule cut on a plastic cam.

Circle 432 on Page 17

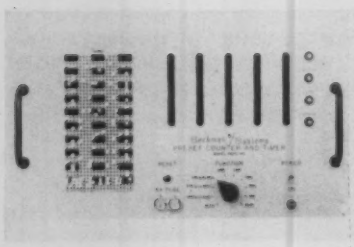


Industrial Servo Valve

Item 433

Designed for industrial hydraulic systems, servo valve is applicable for uses such as the control of automatic machine tools, cigarette making machines, process valve positioning, and positioning and transfer devices. The valve, designated Series 71, features a two-stage, force balance feedback principle with a large, field-replaceable filter. It is available in sizes 1, 2.5, 5, and 10 gpm with 1000 psi valve drop and 20 mma input. System pressures from 500 to 4500 psi can be used and it can be supplied with either a standard connector or terminal box to accommodate the electrical input. **Moog Valve Co. Inc.**, Proner Airport, East Aurora, N. Y.

Circle 433 on Page 17



Counter/Timer

Item 434

Instrument has 20 channels of preset high-low limits, is capable of measuring frequency of a sine wave input from 10 to 1,000,000 cps and time intervals in milliseconds from 1 to 99,999. Limits are set up by means of a pinboard. When used as a frequency measuring device, Model 5690-80 counts pulses for 0.1, 1, or 10 seconds and displays the total on a bank of 5 decimal counting units. The results are multiplied by 10, 1, or 0.1 to arrive at frequency in cps.

To make time interval measurements, the start count signal is entered as a positive or negative going pulse and stopped by a positive or negative going pulse. The interval is counted in milliseconds and displayed on the decimal counting units. The internal clock is a crystal oscillator with a stability factor of ± 1 part per 10^5 per week. **Systems Div., Beckman Instruments Inc.**, 325 N. Muller Ave., Anaheim, Calif.

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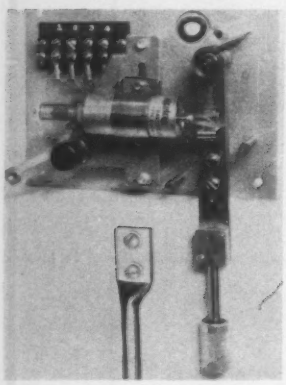
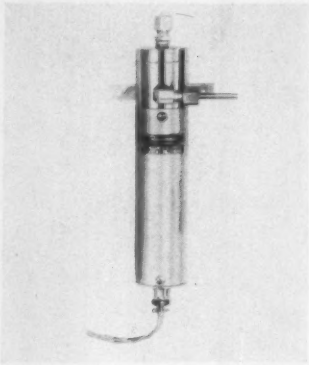


Electronic Edge Control

Item 435

Device requires only $\frac{1}{4}$ oz force to sense edge position of moving strips or sheets of paper, textiles, oilcloth, glass, or metals. It can detect alignment variation up to $2\frac{1}{4}$ inches, is capable of corrective positioning to within 0.001 inch. Detection contacts can be either finger type or roller bearing. The system is based on a null balance principle which is stable in operation under normal variations in temperature, humidity, or supply line voltage. Support of the sensing lever is located so that the feeling edge has a 6 to 1 displacement ratio relative to the transformer armature. The mechanical pickup is connected to a servo controlled hydraulic system where an output signal is fed through an electronic amplifier to a servo motor positioning a hydraulic valve. **Automatic Timing & Controls Inc.**, Dept. 211, King of Prussia, Pa.

Circle 435 on Page 17



Flow Rate Transducer

Item 436

Instrument can sense fluid flows as low as 0.002 gpm and translate the flows, at high static pressure and temperature, into a linear electrical signal. Two units can be connected back-to-back for bidirectional measurements without valving. Transducer, designated Mark X, is a miniature variable area type flow sensor which has a specially shaped body of a fixed size moving in a tapered tube. The core of a differential transformer is attached to the body. The body takes a position in the taper tube as determined by the combined forces of gravity and the velocity of the fluid. This position is measured by the differential transformer, which in turn develops an output voltage proportional to the original rate of fluid flow.

Maximum working pressure is 3500 psi; pressure drop is 2 psi; maximum fluid temperature is 250 F. Flow rate accuracy is 1 per cent of flow rate when calibrated with operating fluid. Voltage output is linear relative to fluid flow rate within 0.5 per cent over rated range. Excitation voltage is 3 v, 60 cycles. Output voltage is zero to 100 mv, 60 cycles. All parts exposed to the fluid are stainless steel. Construction enables the fluid range to be changed in the field. **Ramapo Instrument Co. Inc.**, Bloomingdale, N. J.

Circle 436 on Page 17

Circle 699 on Page 17→

From HANNIFIN... unit construction to give you air valves that do more jobs

Hannifin ⅜" four-way valve with "universal" base and new Speed Control section. Single-solenoid actuated, 10 other actuators available.

Hannifin's exclusive "spool-poppet" seals bubble-tight at either end of its short stroke.

For complete J.I.C. compliance, valve is electrically inoperative until dust-tight, splashproof solenoid cover is replaced and fastened tightly. Result: no more clogged, jammed solenoids.

One of the versatile—and most popular—Hannifin air control valves is this "CC" series, single-solenoid model. It is available for either ¼" or ⅜" air lines and is gasket-mounted to its own base. This particular base (one of three choices offered) can either be O-ring gasketed to your manifold or mounted over an opening in your bracket or machine. It will receive all four lines from below or take the inlet line from below and the two cylinder lines out one side. Or, you can make all connections at the sides.

When it comes to actuation, Hannifin offers an even wider selection: hand, foot, cam, pressure, single or double solenoid.

When necessary, you can remove this entire valve from its base without disconnecting air lines. Or, the exclusive "spool-poppet" can be replaced without even breaking electrical connections.

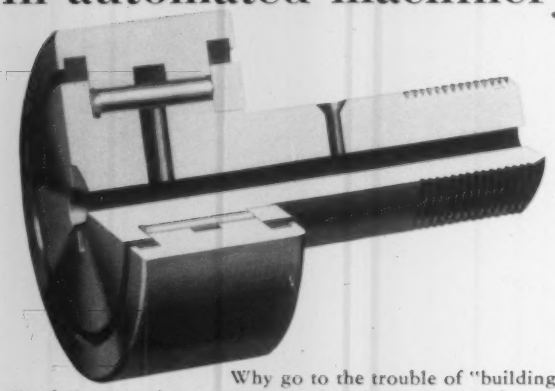
The "CC" series, like all Hannifin valves, is designed with "full flow" internal passages as large or larger than its rated pipe size.

You will find these and most other Hannifin valves described in Hannifin's new "Valve Finder." Get your copy from your Hannifin man, listed in the A-Z volume of Thomas' Register, or write:

HANNIFIN COMPANY
525 South Wolf Road • Des Plaines, Illinois

AUTOMATION TIPS
by McGill

CAMROL® bearings...save the cost– and inconvenience–of improvised followers in automated machinery

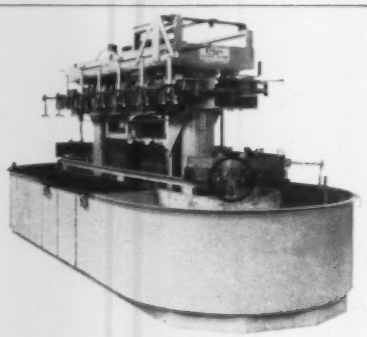


Why go to the trouble of "building up" special roller followers when CAMROL cam followers can provide so many construction advantages in a standard bearing? Select the proper size from roller diameters of ½" to 4" in either the CF (with stud) or CYR (for shaft mounting). It saves time and money when applying roller followers to cam follower, track, guide and support roller applications.

The McGill construction is backed by over 25 years experience with thousands of applications. Selected steel, tested design, special heat treatment and simplified lubrication insures the dependability of CAMROL — the original roller bearing cam follower.

For protected performance, SCF Series Sealed Camrol Bearings provide the added advantages of better lubrication retention and sealing against dust, dirt and other contamination. Frequent relubrication can be avoided.

AUTOMATIC PLATING MACHINES USE CAMROL BEARINGS

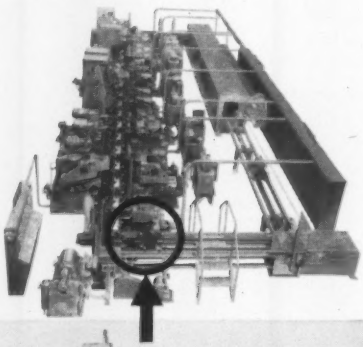


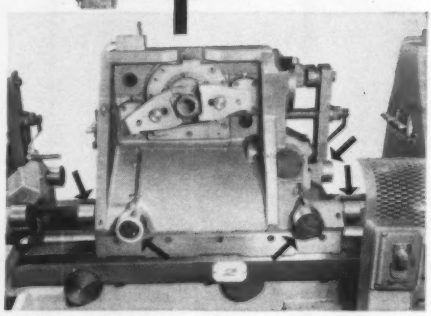
CROWN RHEOSTAT AND SUPPLY COMPANY uses up to 200 Sealed CAMROL cam followers as guide and support rollers in the travel and transfer mechanisms of their cleaning, plating and drying machines. The machine shown here is a CROWN Type "D" Fully Automatic Plating Machine. The CAMROL bearings assure precision action, reduced friction and minimum maintenance. Built-in seals protect the bearings from cleaning and plating solutions.

FOR COMPLETE ENGINEERING DATA ON McGILL PRECISION NEEDLE ROLLER BEARINGS, SEND FOR BEARING CATALOG NO. 52-A

FIXTURES ROLL FREE— and accurately on Sealed CAMROL bearings

Production parts are drilled, milled, bored and tapped in automated systems engineered and built by the BUHR MACHINE TOOL COMPANY. The moving fixtures which hold parts being machined are guided and carried on McGill sealed CAMROL bearings as shown in the close-up below.





By reducing the starting and running friction to an absolute minimum, the CAMROL bearings have made horsepower requirement reductions possible in these systems. Ample load capacity, high resistance to shock loads and integral seals which retain lubrication and keep out contamination have held maintenance down. In the system pictured, 8 SCF-3 CAMROL bearings accurately guide and support each of 28 fixtures. Performance is reported excellent.

engineered electrical products

McGILL®

precision needle roller bearings

SEND FOR CATALOG No. 52-A

MULTIROL — GUIDEROL — CAMROL

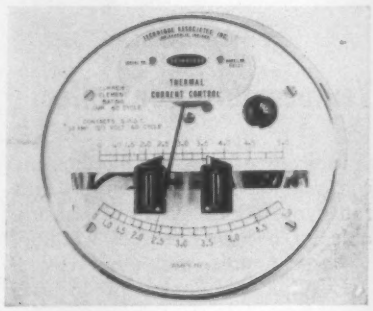
McGILL MANUFACTURING COMPANY, INC., BEARING DIV., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

Photo-Electronic Counter

Item 437

Counting speeds of over 1500 a minute can be accomplished with instrument designated Robot-Eye RE-8. Unit consists of a six-digit amplifier-counter (shown), a photocell, and a light source. Unit counts by interrupted or reflected light beam; there is no physical contact with objects being counted. It has a life of over 100,000,000 counts and replacement counters plug in easily. The amplifier-counter can be remotely mounted and the photocell and light source as far as 10 feet apart. **Standard Instrument Corp.**, 657 Broadway, New York 12, N. Y.

Circle 437 on Page 17



Contact Making Ammeter

Item 438

Instrument is capable of controlling electrical currents in mixing, blending, machining, and electrochemical operations. The meter has a thermal type movement and will detect and control minute changes in ac currents or loads. A set of adjustable contacts and the indicating pointer are used to actuate a built-in relay which will handle loads up to 20 amp directly. The control is a two-position type with an adjustable differential gap. The control points are set by means of two knobs on the dial of the meter. It can be changed or adjusted in the field. Span of the control can be adjusted from 5 per cent up to 100 per cent of the instrument scale. Unit is furnished in ranges from zero to 5 amp or zero to 200 amp for ac loads without using external current transformers and from zero to 5 amp and zero to 10 amp for dc loads. **Technique Associates, Div., Duncan Electric Co. Inc.**, P. O. Box 91, Indianapolis 6, Ind.

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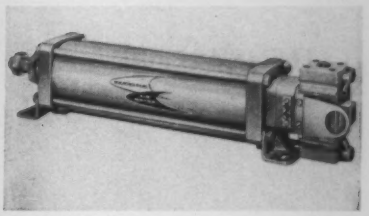


Air Motor

Item 439

Unit is a combination air power cylinder and electrically actuated

Photographs shown above demonstrate clearly the tremendous strides taken in vacuum handling. Prior to installation of VAC-U-LIFT plate handler, the lifting operation required 3 men for operation of crane and attaching chains. The VAC-U-LIFT unit requires only one man for complete operation which means faster, safer and more economical steel plate handling. This unit lifts and conveys over 4½ tons of steel plate and is adaptable for use with overhead traveling crane, boom crane and stiff-leg crane. It is also suitable for handling concrete slabs, smooth stone, glass, and all flat metal sheets. Variations of this unit (through rearrangement of the 16 VAC-U-PADS) allow this unit to lift steel angle irons, pipe, "I" beams, and other heavy, unwieldy steel material.

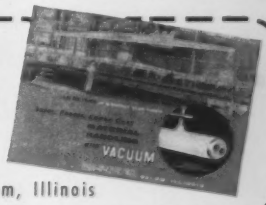
***VAC-U-LIFT SYSTEMS** quickly, economically and safely solve difficult handling problems regardless of weight, shape or size.*

SEND TODAY FOR *FREE* ILLUSTRATED BROCHURE

This brochure shows some of the many VAC-U-LIFT systems now in use. It explains how VAC-U-LIFT works and how you can take advantage of VAC-U-LIFT'S 3-step analyzation service without cost or obligation, write

DEPT. VL-50

VAC-U-LIFT CO. Salem, Illinois



Circle 701 on Page 17

STEEL WAREHOUSE "TAKES TO THE AIR"

Fig. 1 — TRAK-RAK fork lift at top of column, lifting bundle of steel rod. Unit serves 3 long aisles of racks.

TRAK-RAK SYSTEM INCREASES STORAGE SPACE, SAVES 22% CAPITAL BUILDING INVESTMENT

When A. C. Leslie & Co. Limited, needed more storage area in its busy Toronto steel warehouse, it decided to "reach for the ceiling" with a Chicago Tramrail TRAK-RAK System of vertical storage and handling. As a result, the company estimates it not only saved 22% of projected capital building costs, but increased the overall efficiency and speed of the Toronto operation. The company expects to gain further economies as the TRAK-RAK system is used to its full extent.

A 5 ton capacity toprunning TRAK-RAK Crane was installed in each of two 40 ft. wide bays to serve specially designed 18 ft. high material storage racks (Fig. 1) Each crane bridge has an overhead trolley, from which is suspended an electrically operated rotating column

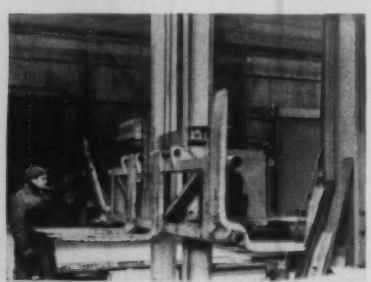


Fig. 2 — Carriage equipped with 2 pairs of forks. Operator is flopping outer forks up.

equipped with a special fork lift. All operations of the fork lift, which revolves to serve either side of the aisles, moves toward or away from the racks, and raises or lowers on the column, are controlled by the operator who rides with the carriage.

Two pairs of forks are mounted on the carriage. The outer forks may be flopped back (Fig. 2) leaving the inside forks in position for handling palletized or crated material. For handling long boxes, bars, etc., the outside forks are flipped back into working position.

A TRAK-RAK feature which added to handling speed and insured safe operation was the safety interlock switch system which prevents the column from running

Fig. 3 — TRAK-RAK column requires minimum aisle space for operation.

into a rack and permits full rotation only when the unit is safely beyond the end of the racks.

The A. C. Leslie Company reports that a similar TRAK-RAK System installed in its Montreal warehouse permitted a 37% savings in capital building investment with equally good operating efficiency and economy.

For complete details on the TRAK-RAK System of vertical storage and handling, write the manufacturer:

CHICAGO TRAMRAIL CORPORATION
1306 S. Kostner Avenue • Chicago 23, Ill.

control valve with built-in speed controls. The square head cylinder has a rustproof body and an induction case hardened piston rod with hard chromium plated finish. The control valve is of a reciprocating disc design and will operate even when the valve is blanketed by chips or grinder dust or splashed with coolant. The speed controls are built into the 4-way valve port plate. They can adjust the cylinder piston speed in both directions. The motor, available in five bore sizes, requires only one air line connection for installation. **Hannifin Co., Dept. 142, 501 S. Wolf Rd., Des Plaines, Ill.**

Circle 439 on Page 17

Temperature Controller

Item 440

Indicating device can monitor and control temperatures within the range of 100 to 400 F. It is suitable for use on bearings, windings of large motors, and other electrical equipment or materials in process. Accuracy for temperature control is ±3 F about the level selected; accuracy for indication by meter reading is ±6 F. An integral indicating lamp signals whenever the controller is functioning to restore temperature to the level desired. Instrument can sense temperature through copper temperature detectors with a resistance of 10 ohms at 25 C. Rated power input is 115 v at 60 cycles Power output is 5 w at 24 v dc, suitable for driving static amplifiers, auxiliary relays, and other control devices. **Westinghouse Electric Corp., Director Systems Dept.**, 356 Collins Ave., Pittsburgh 6, Pa.

Circle 440 on Page 17

ULTRA-NEW!
ULTRASONIC!

DETREX ECONO-SONIC Unit Uses Sound Waves to Get Precision Parts Cleaner, Faster

Ultrasonic cleaning—a combination of solvent vapor degreasing and scrubbing action by high frequency sound waves—gets parts cleaner than is possible by any other method. Costs are reduced and production is increased.

The DETREX ECONO-SONIC dimensions are 24″ x 14″ x 29″ high. This size is ideal for precision part cleaning in small to moderate sized plant operations.

With its own filter, still, pump, heater, spray lance and model 600 generator, it is a complete, self-contained cleaning system. There is nothing else to buy and it installs in minutes.

Where hyper-critical specifications exist, Detrex can supply the additional stages necessary to accomplish an in-line cleaning system. Why not write today and let a DETREX representative show you how an ECONO-SONIC unit, or a larger ultrasonic machine, can improve the quality and reduce the expense of your metal cleaning operation.

Depend on DETREX for Every Metal Cleaning and Processing Need

- PERM-A-CLOR NA (Trichlorethylene)
- Solvent Degreasers
- Ultrasonic Equipment
- Industrial Washers
- Phosphate Coating Compounds
- PAINTBOND Compounds
- Aluminum Treating Compounds
- Alkali and Emulsion Cleaners
- Rust Proofing Materials
- Extrusion and Drawing Compounds
- Spray Booth Compounds

Send for T. J. Kearney's Informative Paper on Ultrasonic Cleaning Techniques.

DETREX CHEMICAL INDUSTRIES, INC.
Box 501, Dept. A-559, Detroit 32, Michigan

World's Largest Exclusive Producer of Cleaning Chemicals and Equipment

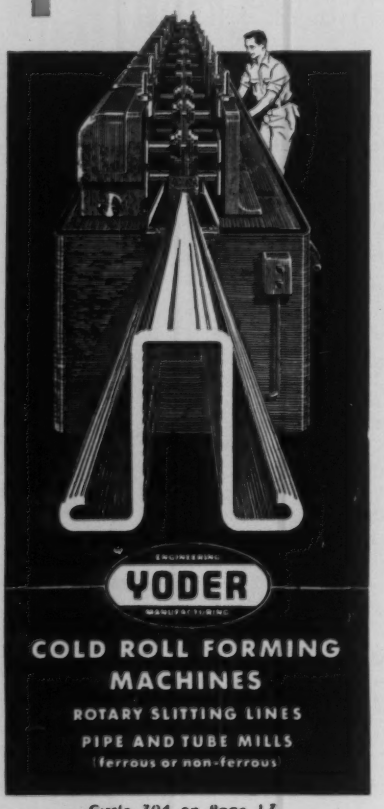
Circle 703 on Page 17

YODER

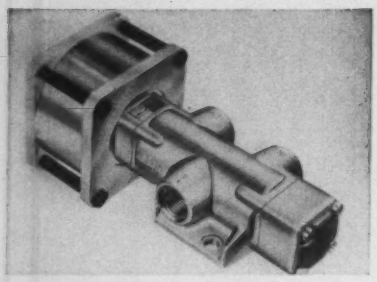
Roll Forming Equipment—Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Roll Forming Equipment Book.

THE YODER COMPANY
5526 Walworth Ave., Cleveland 2, Ohio



Circle 704 on Page 17

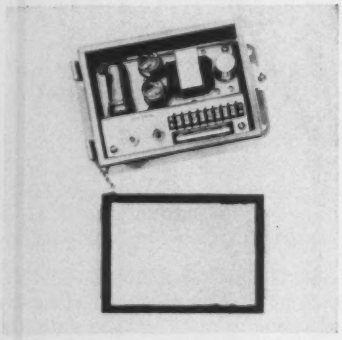


Diaphragm Valve

Item 441

Directional control valve can be actuated by pilot pressures as low as 5 psi on double diaphragm types and as low as 10 psi on standard spring return models. Only a small-capacity control valve is required to operate the diaphragm valve, and actual volume of air used is less than 4 cu in. per actuation. Valve is available in sizes from $\frac{1}{8}$ through 1-inch in 2, 3, 4, and 5-way types, for pressures from partial vacuum to 500 psig. **Versa Products Co. Inc.**, 249 Scholes St., Brooklyn 6, N. Y.

Circle 441 on Page 17



Proximity Control Unit

Item 442

Device, when used with a proximity pickup can provide positive *On-Off* action at the rate of 3600 operations per minute to control transfer machines and counting and batching operations. The pickup is placed at the point of work. It is connected by a cable to the control unit. The pickup responds to metal parts in close proximity and causes the control circuit to operate a relay. The relay, in turn, switches mechanical or electrical equipment *On* or *Off*. This arrangement can be used to detect parts moving past the pickup or to detect stationary parts when they reach a particular level opposite the pickup. The pick-up can be moved from one point to another without dismounting or moving the control unit. Adjustment to the desired operating range is made with a sensitivity control that can be locked in place to guard against vibration. Input for the unit is 117 v, 50/60 cycles ac at 15 w. **Electro Products Laboratories**, 4500 N. Ravenswood Ave., Chicago 40, Ill.

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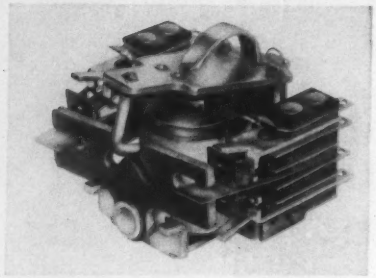


Pulse Relay

Item 443

Alternate pulse relay will transfer contacts when pulsed for approximately 30 milliseconds; the contacts are returned by the next pulse. Once the contracts transfer, no power is required. Contacts are rated at 7.5 amp, 115 v, 60 cycles for resistive loads. It will operate on up to 230 v ac or up to 110 v dc. Switching arrangements up to 3 pdt are available on ac models, 4 pdt on dc models. **Potter & Brumfield, Inc.**, Princeton, Ind.

Circle 443 on Page 17

Dynamic Brake

Item 444

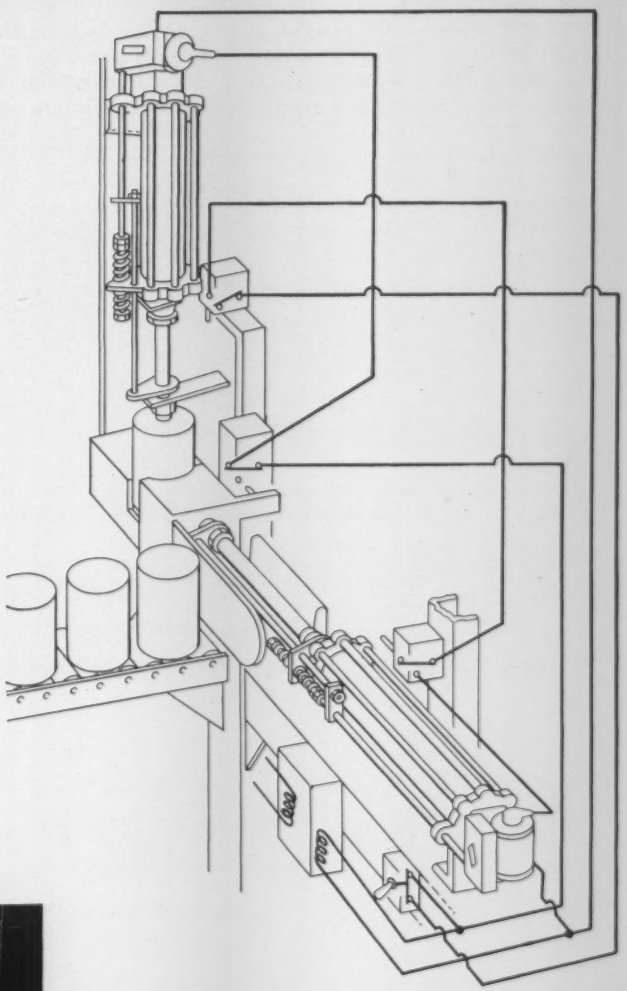
Unit is suitable for rectifiers or equipment requiring a load absorption device for limiting maximum voltage. The brake package requires only two wires for hookup;

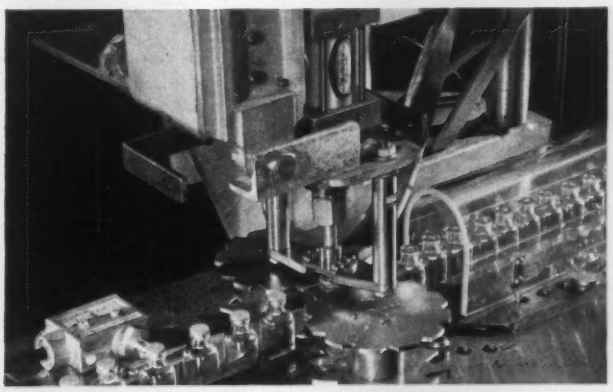
THIS SIMPLE SHOP-BUILT MACHINE SPARKS IDEAS FOR OTHER COST-SAVING UNITS

This SPOT-A-MATION IDEA is another example of how much more simply and economically an operation can be automated using Bellows "Controlled-Air-Power" Devices. The ease of construction and low cost also suggest why these versatile work units have stimulated the imagination and creative ingenuity of cost-conscious men in all types of industries.

Originally designed to punch holes in the bottoms of clay flower pots, this shop-built machine is adaptable to many other operations, such as inserting lids in cans, applying labels, stamping numbers, etc. The two Bellows Air Motors are interlocked to work alternately. A gravity conveyor delivers a clay pot to the first Air Motor, which moves it to a position under the second Air Motor. After the piston rod of the second Air Motor has moved through the work stroke and returned to "up" position, the cycle automatically repeats. This is practical, low-cost automation.

Now, stop a moment and ask yourself a question: "How can I use Bellows "Controlled-Air-Power" to produce more at less cost in *my* plant?"





An adaptation of this SPOT-A-MATION IDEA permitted a drug firm to plug bottles—automatically—four times faster than had been done by two operators. Because sterility was vital, automating the operation with Bellows equipment eliminated the possibility of contamination by human hands.

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains installation data, wiring diagrams and equipment lists for scores of Bellows "Controlled-Air-Power" applications, enabling you to automate existing machines or build your own low-cost special-purpose equipment. Write for yours today. No obligation. Address Dept. AU559, The Bellows Co., Akron 9, Ohio.

13438

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

AKRON 9, OHIO

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

Circle 705 on Page 17

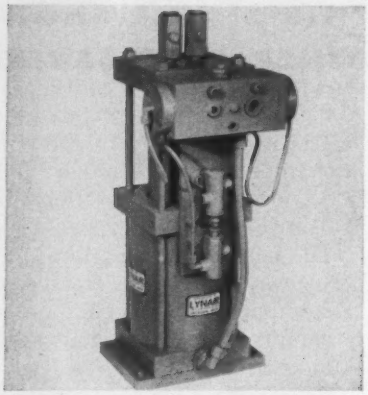
its only moving parts are two relays. Accuracy of repetition is said to be better than one per cent. Design allows the regenerative control to remain on even if electrical equipment fails. The brake package is a single, self-contained unit in sizes up to 5 kw; above this rating, two terminals are brought out to a separate load bank if desired. It is available for voltages up to 600 v dc. **American Rectifier Corp.**, 95 Lafayette St., New York 13, N. Y.

Circle 444 on Page 17

Air Pressure Booster

Item 445

Device automatically boosts air-line pressure in surge tanks and die cushions and maintains constant air pressure on press clutches. It is applicable wherever airline pressure must be boosted. To operate, the air-line pressure is piped to the master control valve and to the intake side of the booster. It will then automatically boost pressure in the desired ratio as it is needed. Unit is furnished in ratios

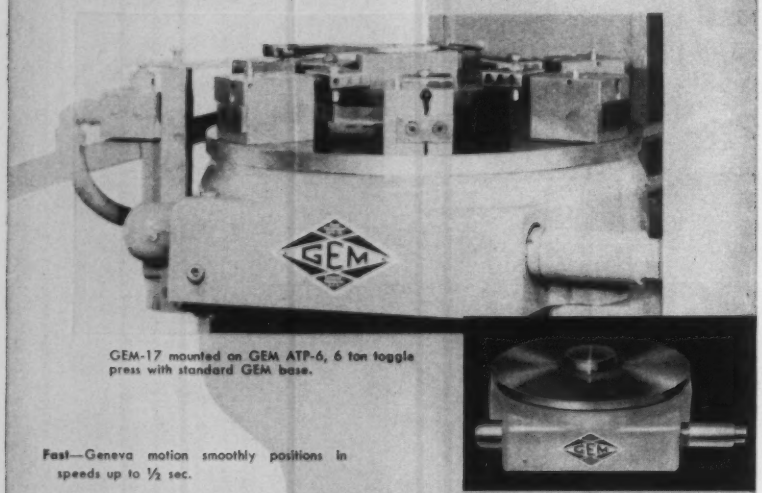


from 1.5:1 to 6.25:1. Numerous mounting styles are available such as foot mount, flange mount, side mount, and end lug mount. **Lynair Inc.**, Dept. A-B, 3100 E. Michigan Ave., Jackson, Mich.

Circle 445 on Page 17

precision indexing to ±0.001"

. . . WITH GEM-17 DIAL INDEX TABLE



GEM-17 mounted on GEM ATP-6, 6 ton toggle press with standard GEM base.

Fast—Geneva motion smoothly positions in speeds up to ½ sec.

Rugged—1000 lb. work load with solid anvil capacity of 30 tons.

Positive lock—Bolt in Geneva slot cammed both in and out given positive locking.

Power—Comes complete with rotary air motor, solenoid valve with limit switch (fluid or electric motors available).

Number of stations—6, 8 or 12 standard, 3 and 4 skip.

Size and weight—200 lbs. complete with 17" dia. table (plates up to 36" available).

Geneva Motion GEM-17 Indexing Table standardizes automation on your assembly and machining operations . . . drilling, tapping, riveting, spinning, staking, knurling, chamfering, welding, screwdriving, stud driving and gaging to the speed and accuracy required. Gray's complete engineering staff can adapt the table to your work problem.

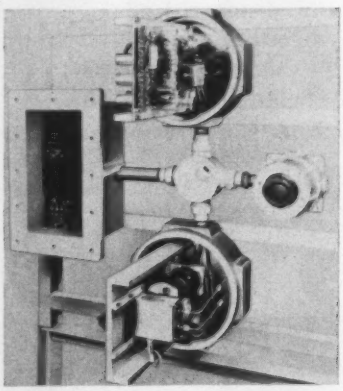
Send for Bulletin DI-17 and complete information.

gem **GRAY equipment company**

automatic assembly equipment

13600 Ford Road • Dearborn, Mich. • Telephone: Tiffany 6-7373

Circle 706 on Page 17



Photometric Analyzer

Item 446

Instrument can provide precise measurement of water concentration in ranges from parts per million to percentage magnitudes in liquid or gaseous process streams. Designed to measure almost any material which absorbs in the near infrared, unit is appropriate for measuring water in alcohols, aromatics, reformer feed, and other hydrocarbon and chemical streams. The analyzer measures the ratio of transmission at two different wave lengths. A photoconductor is used as a detector while interference filters are used to isolate the selected wave lengths. **Analytic Systems Co.**, 980 N. Fair Oaks Ave., Pasadena, Calif.

Circle 446 on Page 17

THE LINK BETWEEN ELECTRONIC CONTROL AND HYDRAULIC POWER

Expert Welding Machine Co. Solves the High Production Contour Welding Problem With

VICKERS®

Electro-Hydraulic Servo Valve

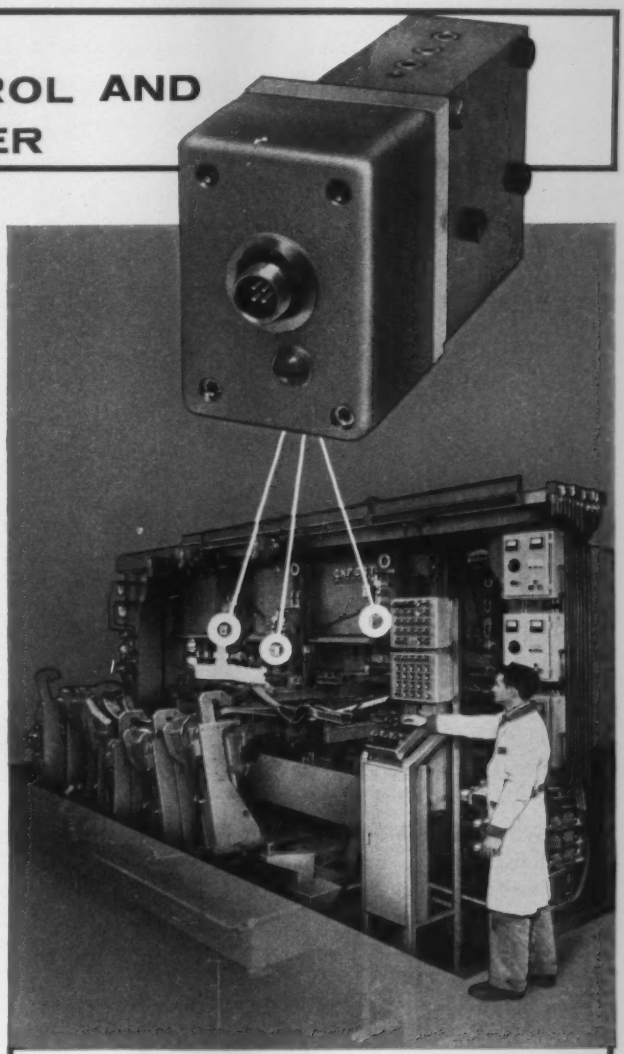
The versatility of electro-hydraulic control of power has solved one of industry's toughest problems — automatic welding of complex and contoured automotive frame members.

An electronic probe follows the weld line on the work and records any deviation from the path prescribed by a master cam. Any deviation from the governing cam contour creates an error signal which is amplified and fed to the servo valve. The servo valve converts these electrical signals into precise hydraulic flow to a cylinder which accurately positions the welding head allowing for variations in manufacturing operations . . . trimming, etc.

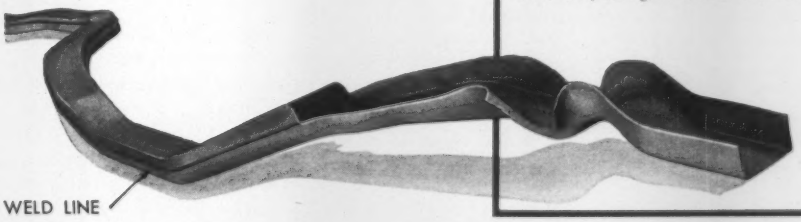
This application is only one of many in which Vickers Servo Valve has demonstrated exceptional performance under the exacting conditions of industrial production requirements.

Valve operation is simple. Reliability is assured—there are only four moving parts.

Investigate the production advantages offered by electro-hydraulics. **Write for Vickers Engineering Bulletin 58-74.**



EXPERT WELDING MACHINE COMPANY developed this automated welding machine that incorporates a magnetic-tape-tracer system. Vickers electro-hydraulic servo valve provides the link between electronic programming and hydraulic power. Vickers Pumps and Controls also used. The machine joins metal parts having untrimmed, out-of-tolerance, straight and/or contoured weld line edges.



Two U-shape channels are welded to form the box configuration in this complex automotive frame side member. Production is approximately 100 pcs/hr.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1536 • Detroit 32, Michigan

8259

Application Engineering Offices: ATLANTA • CHICAGO* • CINCINNATI • CLEVELAND • DETROIT* • GRAND RAPIDS • HOUSTON • INDIANAPOLIS • LOS ANGELES AREA (El Segundo)* • MILWAUKEE • MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE* • ST. LOUIS • TULSA • WORCESTER • Factories also in: Australia, England, Japan and Germany • In Canada: Vickers-Sperry of Canada, Ltd., Toronto,* Montreal and Vancouver
Field Service Headquarters Underlined. Whse. Stock & Repair Branches*.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Circle 707 on Page 17

When "The Man from Logan" visits you, he brings with him the total engineering recall of the Logan Co. He relates your particular conveyor installation with other custom jobs—he "remembers" systems from times before you and he were born . . . other systems so new they are still on Logan drawing boards hundreds of miles away. Your new conveyor will be the unique, imaginative answer to your special needs but founded squarely on more years of experience—more successful installations—than any other conveyor company can draw upon.

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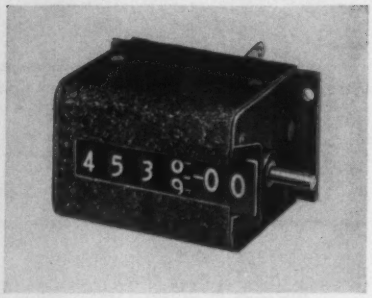
"The Man from Logan" assumes full responsibility for your job, from design to guaranteed smooth operation. Call him in and be assured of the *one* best conveyor for your needs, at the lowest feasible cost. Write or phone today.

Meet "The Man from Logan" at the MHI Show, Booth 806

Logan Conveyors

LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.

Circle 708 on Page 17

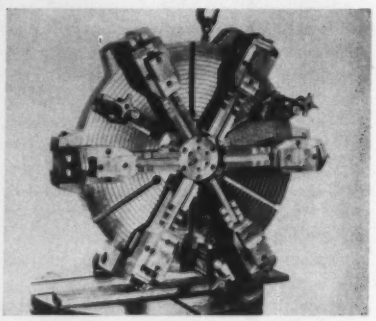


Mechanical Counter

Item 447

Instrument can operate continuously at 6000 rpm. Counter has a directly-geared second wheel which is designed to reduce the wear that results from standard transfer-pinion methods. A feature of the unit is that it provides an instantaneously corrected direct reading in the event that the second wheel is not fully within the window (as shown in the photo). Other features are its high resistance to corrosion, humidity, and vibration. **Veeder-Root Inc.**, Hartford 2, Conn.

Circle 447 on Page 17



Universal Chuck

Item 448

Thirty-inch diameter chuck is designed to allow control of the chucking pressure exerted on the workpiece. It is adaptable for gears, rounds, and odd-shaped workpieces and can be used on any machine that has a hole through its workspindle. Jaws of the chuck open wide for easy loading and unloading and rapid setup and changeover. The jaws pull the workpiece back into the chuck against positive rest stops. The amount of pressure exerted on the workpiece is dependent on the drawbar pull; not on the size of the workpiece. By increasing the

Professional Personnel Requisition

Controls & Instrumentation Engineers

Marquardt Aircraft—a leader in air and space propulsion and control systems, high altitude rocket research and weapon support systems—offers a creative engineering environment in which you will find significant active projects. These include engine control systems for nuclear turbojet, inlet control systems for the North American F-108 and Hound Dog missile, control systems for the supersonic ramjet engine, feasibility studies of advanced and unique engine cycles, nozzle control for advanced ballistic missile components and other power system actuators. These control units include fluid and gas operated servo systems suited for environments above one thousand degrees.

If you are an engineer experienced in fluid dynamics or fluid operated controls and interested in mechanisms designed for severe environmental conditions, you should consider one of the following engineering opportunities at Marquardt:

CONTROLS DESIGN

To create components for pneumatic and hydraulic control systems. Work ranges from simple piston actuators to complex speed computing devices. All designed for high sensitivity, fast response, extreme environmental conditions and light weight. Should be experienced in machine design and have an understanding of basic design analysis.

CONTROLS ANALYSIS

To investigate aircraft and missile control problems through the application of analysis methods in mechanics and dynamics, heat transfer, compressible flow, and servomechanisms. Position offers opportunity for creative engineering.

CONTROLS DEVELOPMENT

Opportunity to create workable controls components. Must have a "feel" for hardware and desire to undertake broad engineering responsibility. Opportunity to solve "on-the-spot" engineering problems utilizing pneumatic and hydraulic control analysis techniques.

ENGINEERING STANDARDS

Implement, establish and/or originate the use of standards both design and hardware for reduction of time and cost of engineering effort. Must have knowledge of hydraulic and pneumatic design and components. Should be capable of setting up an evaluation program as required. Requires ability to work with many engineering groups both in advisory and service capacity.

CONTROL RELIABILITY

To predict reliability of control of units and recommend appropriate design changes. Knowledge of servomechanisms and feedback theory desirable. Should have background in statistics and experience in reliability field.

INSTRUMENTATION

Specification and design of instrument components and systems for ground testing of supersonic ramjet engines, jet engine components, inlet controls, nuclear powerplant controls and emergency power units. Prefer instrumentation experience, including data acquisition and processing equipment. Familiar with process control systems.

For additional information, please write

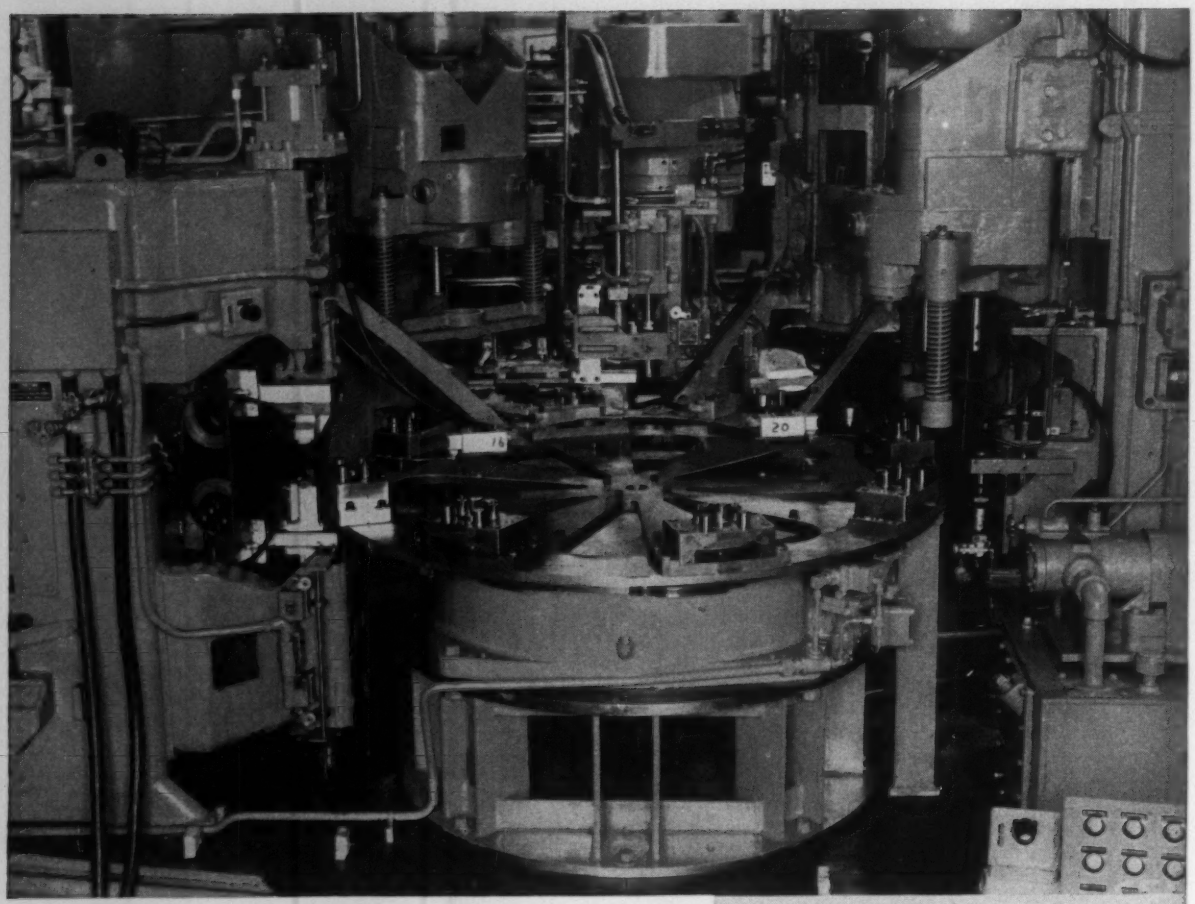
Mr. Floyd E. Hargiss, Manager
Professional Personnel, Dept. L-1
Marquardt Aircraft Co.
16555 Saticoy Street
Van Nuys, California

Marquardt AIRCRAFT CO.

VAN NUYS AND POMONA, CALIFORNIA—OGDEN, UTAH

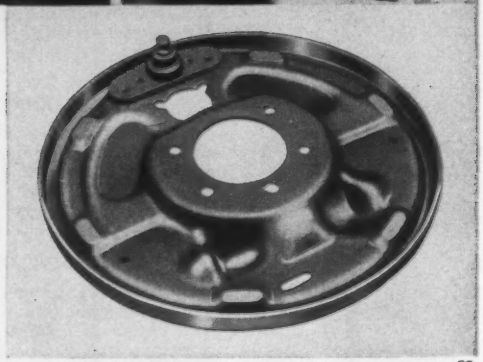
COOPER DEVELOPMENT CORP.—MONROVIA, CALIFORNIA—A MARQUARDT SUBSIDIARY

Circle 709 on Page 17



THIS NATIONAL ELECTRIC MULTI-STATION DIAL FEED MACHINE

paid for itself in 9 months!



52

Loading, resistance welding, hydraulic reaming, hopper feeding, pressing, hot upsetting and hollow milling are the seven operations—performed automatically—on automotive brake backing plates by this one National Electric Dial Feed Machine. The installation of this unit, by an automobile manufacturer, not only released eight machines for other production, but saved a corresponding amount of floor space as well.

This is only one example of the money and man-hour savings realized when National Electric Automatic Welding Machines are employed. National Resistance Welders, Gas-shielded Arc Welders and Submerged Arc Welders . . . meet the high-speed assembly-line methods and close tolerances demanded throughout American Industry. A National Electric Welding Machine can be developed to fill requirements of any volume welding job. Write today for information.

NATIONAL

ELECTRIC WELDING MACHINES CO.

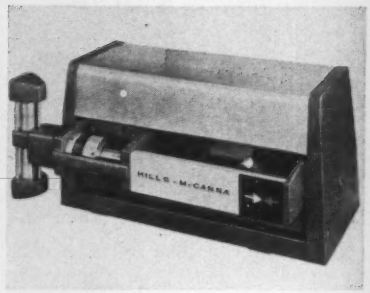
1870 N. TRUMBULL STREET
BAY CITY, MICHIGAN

25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

Circle 710 on Page 17

chucking pressure, the unit can be used to true up parts which have become distorted in heat treating. **Garrison Machine Works Inc.**, 515-525 Bannock St., Dayton 4, Ohio.

Circle 448 on Page 17

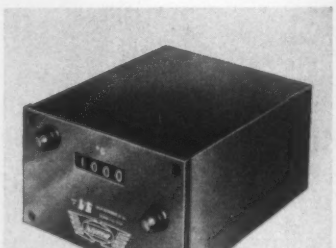


Metering Pump

Item 449

Applicable in chemical proportioning, water treatment, or petroleum processing; crank-type pump is available in four models for capacities from a fraction of a gallon to 1030 gph per feed. At full stroke the angularity of the connecting rod is 9 degrees from the axis of the plunger. This feature is said to minimize wear on the plunger guide bushing. The check valve assembly has a straight-through flow, is replaceable on the pump body. The separate foot-mounted motor and speed reducer can be individually replaced without moving the pump. **Hills-McCanna Co.**, 4600 W. Toúhy Ave., Chicago 46, Ill.

Circle 449 on Page 17



Millivolt Indicator

Item 450

Analog-to-digital millivolt meter indicator is a servo-driven null balance slidewire potentiometer unit with transistorized amplifier and referenced power supply. The slidewire is formed by bonding a resistance wire within the edge of a laminated tape. Contained on two spools, the slidewire tape is transported between spools by a sprocket drive. The slidewire is calibrated in an automated test system whereby the slidewire is compared to a master tape 60 feet long. During calibration, digital values as specified are automatically printed on the face of the tape or the tape is perforated for engagement of a positioning and driving sprocket.

Meter is available with two readout arrangements. With the calibration printed on the tape and viewed through a window in the front of the case, linear, parabolic, hyperbolic, or logarithmic functions in any scale units can be presented with an accuracy of 0.1 per cent. With a digital in-line counter (shown) geared to the slidewire drive shaft, functions with a varia-

Wherever you use compressed air...

...just PLUG IN THE POWER

with HANSEN Quick-Connective Couplings

As easy as plugging in your electric shaver

To connect the Coupling, just push the Plug into the Socket—with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket. Coupling disconnects with instant, automatic shut-off of air.

Quick Connection and Disconnection

Instant Automatic Flow or Shut-Off

Blue section shows how Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

Write for Hansen Catalog

—a ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

Quick-Connective Fluid Line Couplings for

AIR • OIL • GREASE • HYDRAULIC FLUIDS • WATER • VACUUM • STEAM OXYGEN•ACETYLENE•REFRIGERANTS GASOLINE • COOLANTS • LP-GAS

Representatives in Principal Cities

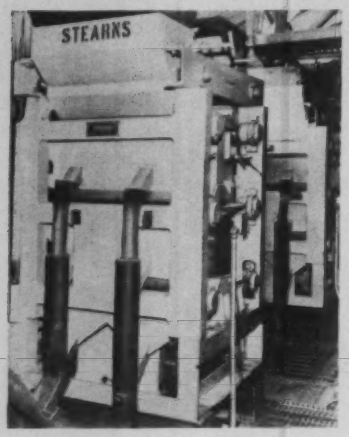
THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 35, OHIO

Circle 711 on Page 17

tion of 15 per cent in slope can be accommodated. **B & H Instrument Co. Inc.**, 3479 W. Vickery Blvd., Fort Worth 7, Tex.

Circle 450 on Page 17

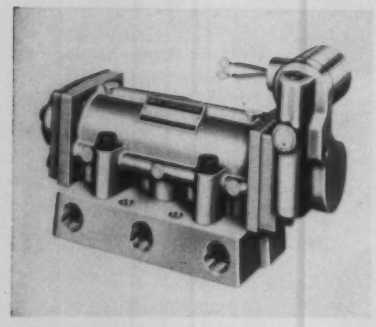


Magnetic Separator

Item 451

Induced roll type unit is designed with a number of magnetized rolls which are arranged vertically. Each roll revolves in a controlled magnetic circuit. Material to be processed is fed to each roll successively by gravity. Magnetically responsive particles are deflected from the normal path as the feed passes over the magnetized roll. Final separation of the least responsive material takes place at the last roll, where magnetic intensity is strongest. **Stearns Magnetic Products**, 635 S. 28th St., Milwaukee 46, Wis.

Circle 451 on Page 17



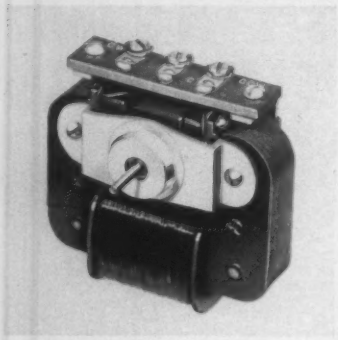
Poppet Pilot Valve

Item 452

Single and double solenoid operated control valves have a full ½-inch flow (257 cfm at 100 psig). Housings of these valves are aluminum castings. The valve chambers in the straight-through bore are formed with metal spacers that position the packings accurately and support them on both the inside and outside diameters without placing them under mechanical pressure. Flow is through the hollow, radially ported, stainless steel plunger and out the connected piping.

Fluid pressure is used to operate the valve. This method permits the use of smaller, shorter stroke solenoids. The bucking cylinder cap of a single solenoid valve can be removed and a solenoid end cap substituted, permitting a single solenoid valve to be changed over to double solenoid operation. Units are available in 2, 3, or 4-way models; 2 and 3-position designs. The valves are equipped with subplates either side or bottom tapped for ⅜ or ½-inch pipe connection. **Hunt Valve Co.**, Salem, Ohio.

Circle 452 on Page 17



Tachometer Generator

Item 453

Reversible shaded-pole motor is constructed to meet the requirements of an ac tachometer or rate generator. With rated ac voltage applied to the main winding, a voltage is generated in the shading windings which is proportional to the speed at which the rotor is driven. Voltage is nearly linear from 1000 to 3000 rpm. Generated voltage from a typical rate generator with low impedance shading coils (150 ohms) is two volts per thousand rpm and can be increased to ten volts per thousand using shading coils of higher impedance. **Small Motors Div., Barber-Colman Co.**, Rockford, Ill.

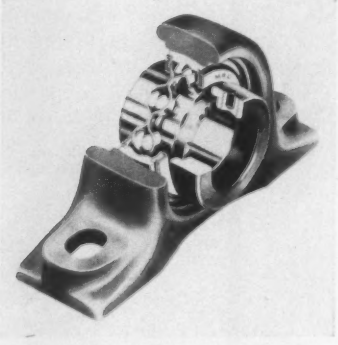
Circle 453 on Page 17

Air Filter

Item 454

Applicable on instrument panels, air checking gages, paint spraying and food processing equipment, air filter will remove traces of oil and micronic contamination to as small as five mu from compressed air systems. An absorbent disposable textile cartridge called *Micro-Pak* is incorporated in the unit and can be easily changed. Filter can handle volumes of air as high as 150 cfm at 100 psi with minimum pressure drop. It is available in pipe sizes from ¼ to 1-inch, will operate on pressure up to 250 psi. **Wilkerson Corp.**, 1552 W. Girard Ave., Englewood, Colo.

Circle 454 on Page 17



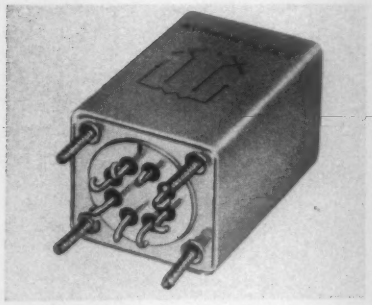
Pillow Block

Item 455

The ball bearings used in line of pillow blocks are prelubricated at assembly and eliminate the need for any further lubrication. Design of the pillow block permits the bearing to adjust to shaft misalignment and maintain full contact seating of the bearing housing. It is interchangeable with most types of pillow blocks. Positive locking on the shaft is accomplished by a cam

action locking collar which engages an eccentric land on the bearing inner ring. After the collar is positioned and the set screw is tightened on the shaft, the locking collar becomes tighter as the shaft rotates. **Marlin-Rockwell Corp.**, Jamestown, N. Y.

Circle 455 on Page 17

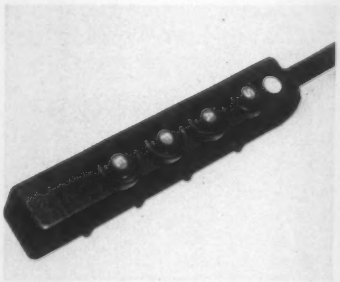


Power Relay

Item 456

Miniature relay is rated at 25 amp at 115 v ac for resistive loads, has a minimum life of 100,000 operations at rated load. Model 26S20 is hermetically sealed, features self-wiping contacts. It can be externally wired for double-make or break operations. Operation is at 115 v ac nominal, double pole with standard operating power of 4 va. **Kurman Electric Co., Div., Norbute Corp.**, 191 Newel St., Brooklyn 22, N. Y.

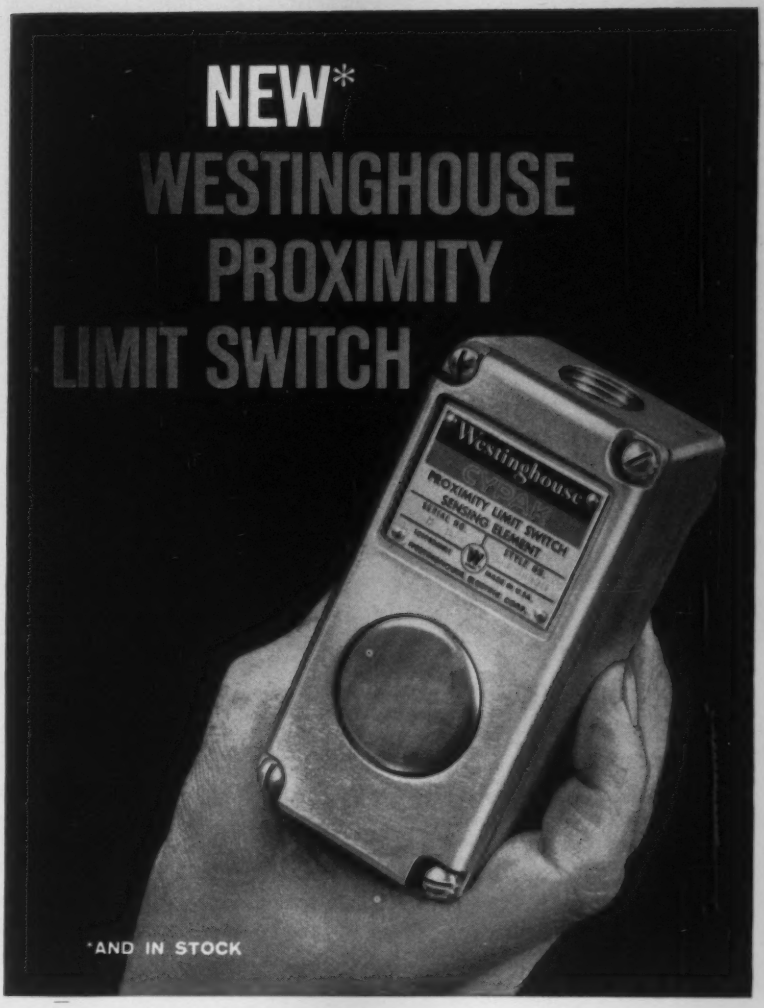
Circle 456 on Page 17



Pushbutton Station

Item 457

Waterproof, noncorrosive construction is available in either 3 or 4-button models. The light weight pendant-type station is applicable on hoist and crane operations or it can be suspended above heavy machinery. Each button is an integral part of the 2-piece Neoprene housing and completely encloses the



...WON'T WEAR OUT...
NEVER NEEDS REPLACEMENT

No tubes . . . no moving parts to weaken and fail from wear . . . not affected by dust, dirt, oil mist or iron filings . . . will even operate under water . . . sensing heads available for distances of ½ inch and 2 inches . . . also for explosion-proof applications . . . corrosion and vibration resistant . . . won't spark, pit or wear, because there are no contacts.

Sure, they cost a little more initially. But we haven't seen the application yet where the new Westinghouse proximity limit switch can't pay for itself time and again through eliminated replacements and machine down time.

GET ALL THE FACTS about new Westinghouse proximity limit switches . . . see how and where they can benefit you. Write to Westinghouse Electric Corporation, Director Systems Department, 356 Collins Avenue, Pittsburgh 6, Pennsylvania. J-01011

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

Circle 712 on Page 17

Faster Cycles; and More Output

with Less Fatigue and Higher Sustained Production

Machine speed — not worker efficiency — governs production on automatics equipped with Lipe Automatic Machine Loading Bar Feed. That's because Lipe takes over the tedious, back-breaking hand-loading — leaves the machinist free to concentrate on quality . . . machine set-ups . . . care of tools.

The LIPE AML Bar Feed

automatically and continuously feeds stock of practically any length, shape or material in close-tolerance feedouts. Users report production increases of 40% . . . 90% . . . even 200% per machine, plus labor benefits that are even more important. We'd be glad to give you a fair estimate of what Lipe can do for you. Just send prints of samples or some typical work.

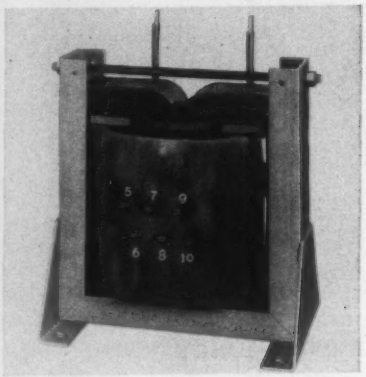
Stop Cutting Air and you Start Cutting Costs

Lipe-ROLLWAY CORPORATION SYRACUSE 1, N.Y.

PIONEERS IN PNEUMATIC BAR-FEEDING

snap action switches. A ring-shroud design protects each button from accidental action from any lateral direction. Interior design of the unit provides enough room for easy wiring. **Electrical Products Div., Joy Mfg. Co.**, Dept. P-21, 1201 Macklind Ave., St. Louis 10, Mo.

Circle 457 on Page 17

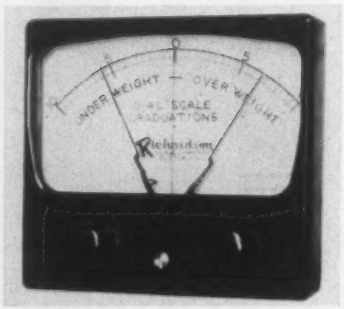


Magnetic Amplifier

Item 458

Line of power magnetic amplifiers is available in 18 sizes, from 500 va to more than 32 kva. A feature of the unit is the tapewound gapless core which permits a minimum of control ampere-turns and is designed to eliminate any irregular performance resulting from air gaps. This line of amplifiers is designated Series 1290. **Electric Products Div., Vickers Inc.**, 1815 Locust St., St. Louis 3, Mo.

Circle 458 on Page 17



Off Weight Indicator

Item 459

Designed for use with company's automatic proportioning system, instrument provides a visual indication of the number of "off weight" graduations for each ingredient

weighed by the system. It is possible to correct a trend to overweighing or underweighing before the actual limit of tolerance is reached, thereby preventing spoiled mixtures. If an off weight equal to or greater than the preset tolerance occurs, the system stops until the off-weight condition is corrected or until it is accepted by operation of a keyed by-pass switch. Adjustment of the overweight and underweight tolerance is from one to ten dial graduations. Linearity and accuracy of the meter is $\pm 1/2$ a dial graduation. **Richardson Scale Co.**, Clifton, N. J.

Circle 459 on Page 17

Flow Integrator

Item 460

Suitable for automatic batching applications and for billing or record purposes, Model MPT-53 consists of a synchronous, motor-driven digital counter which is actuated by energy from a photocell. Flow rate is indicated on a $4\frac{1}{4}$-inch indicating scale and is totalized every three seconds on a 5-digit counter. A light source provides excitation to the cell. The duration of photocell's exposure to the light is determined by a timing disc and a characterized flow sensing cam, permitting the counter to run in direct proportion to the rate of flow. A transistorized amplifying circuit and plug-in relay with dust-tight enclosure are used in the system. The unit does not integrate below approximately 10 per cent of maximum flow rate and will not totalize even if left on when no flow is passing through the rotameter. **Brooks Rotameter Co.**, P. O. Box 432, Lansdale, Pa.

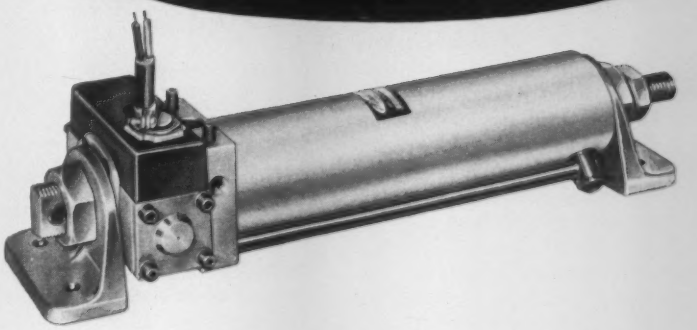
Circle 460 on Page 17

Now—SAVE SPACE, WEIGHT & PIPING

with **NEW**

Modernair
Trademark

VIH (VALVE -IN- HEAD) **CYLINDERS**



Here's a combination that's hard to beat — a performance-proved industrial air cylinder with its own built-in directional and exhaust speed control valves — in a single, compact "package". Check these important features:

- **BUILT-IN DIRECTIONAL CONTROL VALVES...** your choice of four control combination; double solenoid, single solenoid with button bleeder return, double button bleeder, or double remote pilot pressure operation.
- **BUILT-IN EXHAUST SPEED CONTROLS** with automatic Nylon lock.
- **INTERCHANGEABLE MOUNTINGS...** front or rear flange, low or high "L" foot brackets, rod and cylinder clevis.
- **SINGLE CONDUIT CONNECTION** for double solenoid unit.
- **AVAILABLE WITH CUSHIONED STOP** either or both ends.
- **PERFORMANCE-PROVED MODERNAIR CONSTRUCTION**

Condensed Specifications

DIAMETERS: 1½", 2", 3"
ROD SIZES: ½", ⅝", ¾"
MIN. OPERATING PRESSURE: 20 p.s.i.
SOLENOID POWER REQUIRED: 10 watts
MAX. OPERATING PRESSURE: 150 p.s.i. (solenoid) 200 p.s.i. (bleeder or pilot pressure)
SOLENOID COILS AVAILABLE: (ac) 8-10, 110, 220 v. (dc) 12, 24, 30 v.

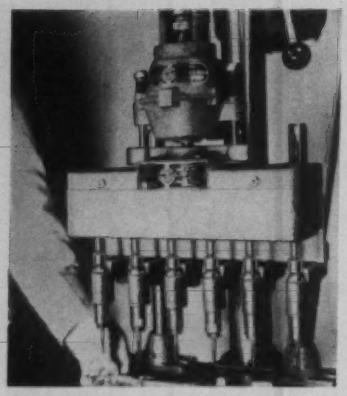
Call your local MODERNAIR sales outlet (see Modernair trademark under "CYLINDERS" in the yellow section of your phone book) or write us today for complete data bulletin; please address Dept. C-5.

Modernair

CORPORATION

400 Preda Street • San Leandro, Calif.
5007 Brookpark Rd. • Cleveland 34, Ohio

Circle 715 on Page 17

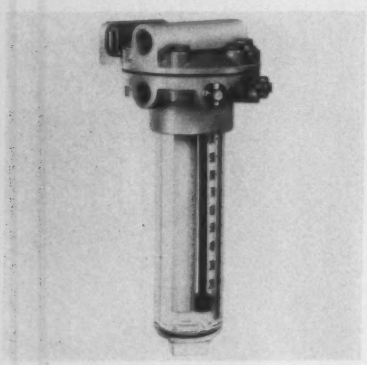


Multiple Spindle Head

Item 461

Unit has six adjustable, ball-joint type spindles for drilling or tapping a variety of hole patterns. It will operate in any position on any drill press, drill unit, or tapping machine. Individual spindles can be located anywhere within 3-inch diameter circles, with a 15/16-inch minimum center distance. They run in grease lubricated oilite bushings. The gear case is constructed of aluminum alloy; provides a 1:1 grooved precision type ball thrust bearing for each spindle. Guide bushings in the gear case permit the use of guide rods and provide better alignment and rigidity. **Ettco Tool & Machine Co. Inc.**, 594 Johnson Ave., Brooklyn 37, N. Y.

Circle 461 on Page 17

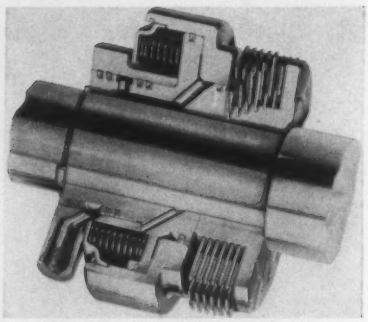


Liquid Chemical Feeder

Item 462

Instrument meters, regulates, and feeds liquid chemicals continuously into a liquid stream at flow rates ranging from 0.1 to 4 gallons per day. It is designed for hypochlorite solutions, defoaming agents, rust and scale inhibitors, wash water detergents, and slime control agents. The feeder, designated Micro-H, is semiautomatic; features a built-in ejector, a corrosion-proof plastic body, and a porous stone to feed the liquid chemical. The chemical must be free of suspended solids and have sufficient transparency to permit the scale to be seen. **Fischer & Porter Co.**, 27 Jacksonville Rd., Hatboro, Pa.

Circle 462 on Page 17



Hydraulic Clutch

Item 463

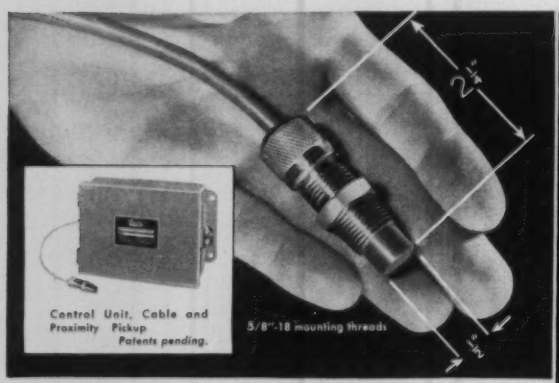
Actuated by oil pressure of 100 to 300 psi, wet-type, multiple-plate clutch is applicable for machine tools and transmissions. Model DOC (shown) has an integral oil collector, is available in sizes from 3 to 7 inches in diameter. It can transmit up to 137 hp and up to 690 lb-ft of torque. Forced cooling can be used by pumping oil through the plate stack to increase horsepower capacity by 30 or 40 per cent. For high speed operation, the release spring cavity of the clutch can be flooded with oil to equalize the centrifugal pressure heads on each side of the piston. Another available clutch (Model DO) is similar in application and design except that the around-the-shaft collector is omitted, shortening the clutch. **Twin Disc Clutch Co.**, Racine, Wis.

Circle 463 on Page 17

Thermostat

Item 464

Unit is composed of three sub-assemblies; a thermoswitch unit, stainless steel well, and an explo-



Solve your metal control problems with this low cost proximity pickup

Compare these advantages over other proximity devices

• Detects ferrous and non-ferrous metals • Sensitive to tin foil • Control Unit can be located 50 feet or more from pickup • Replacement cost only $13.50 • Pickups sealed against water and oil • Meets JIC requirements. Variety of models for detecting metal objects at clearances over six inches; also Hollow Coil Pickups for detecting and counting small metal parts.

Control Unit contains relay output for direct operation of motor controls, solenoids and electric counters.

Write or Phone for Bulletin and Name of Nearest Field Engineer

Electro

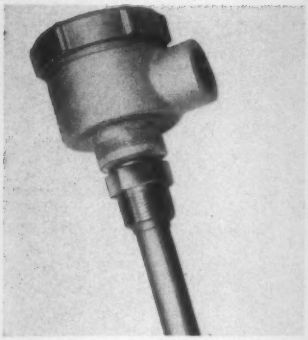
ELECTRO PRODUCTS LABORATORIES
4501-A Ravenswood, Chicago 40, LOngbeach 1-1707
Canada: Atlas Radio Ltd., Toronto

Unlike others

Electro

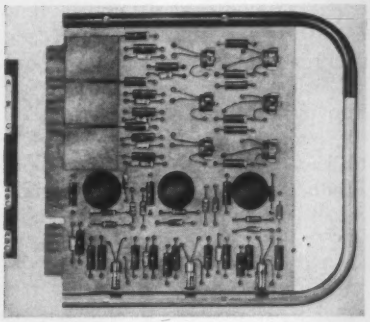
pickups are unaffected by nearby 60 cycle AC fields

Circle 716 on Page 17



sion-proof junction box which completely protects the lead wire outlets. It will provide reliable operation when immersed in tanks, installed on the wall, or exposed to contaminated environments. Thermostat is adjustable over a 32 to 500 F range and can be exposed indefinitely to −100 F or, for short periods, to 100 F above its set point. Current rating is 10 amps, 115 v ac or 5 amps, 230 v ac. **Fenwal Inc.**, Pleasant St., Ashland, Mass.

Circle 464 on Page 17



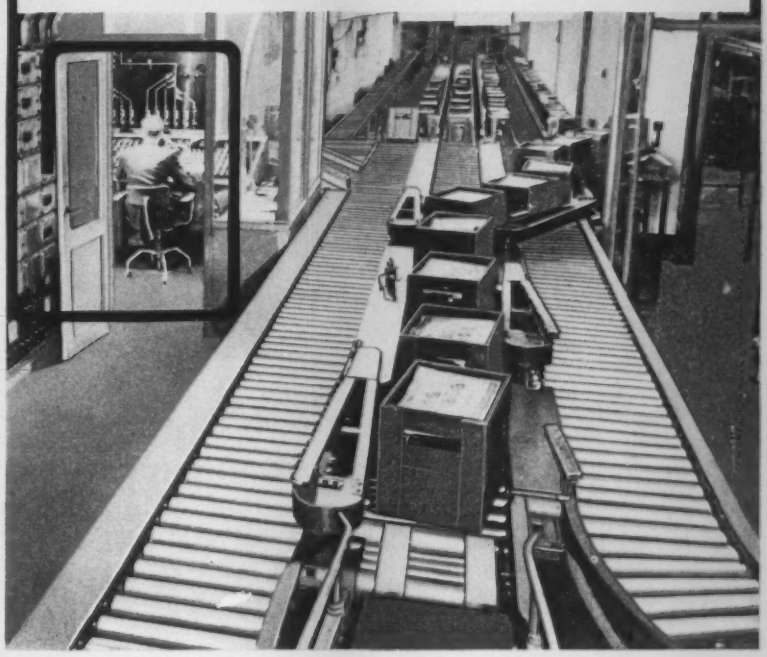
Magnetic Memory System

Item 465

Designed for use with digital data handling equipment, Model 3C incorporates transistorized plug - in packages to handle core matrix driving and sensing circuits. The system has a 4096-word capacity and 40-bit word lengths. Access time to any address is 4 microseconds and cycle time between successive address locations can be as short as 8 microseconds. The basic core memory building blocks consist of a sense amplifier, a current driver, inhibit driver, and selection switch packages. It will operate on 275 w from a 115 v, 60 cycle source. **Computer Control Co. Inc.**, 92 Broad St., Wellesley, Mass.

Circle 465 on Page 17

1 MAN ALONE OPERATES PLANTWIDE A-F ENGINEERED CONVEYING SYSTEM



Just 1 man, sitting at the control panel shown above automatically controls the *starting* and *stopping* of *all* or *part* of this A-F Engineered Completely Co-ordinated Conveying System. He also routes and switches "trains" of cases on 5 A-F Conveyor lines to 2 groups of loading docks . . . Cases are automatically counted as they are being moved . . . Visible and audible signals prevent traffic jams . . . Before you order any type of conveyor, better write us. We'll be glad to submit an estimate.

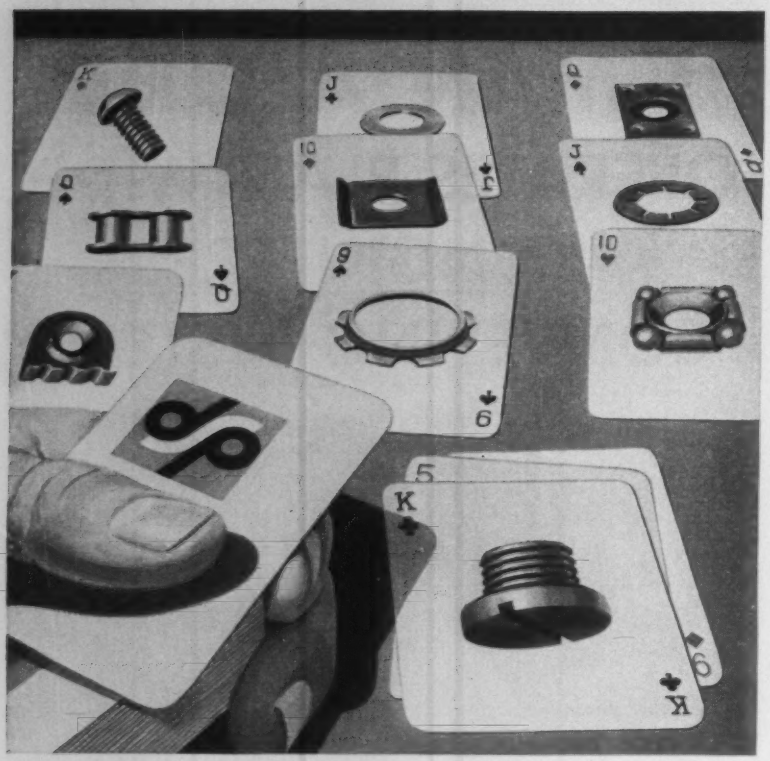
YOU CAN SEE THE SUPERIORITY OF A-F CONVEYOR ENGINEERING

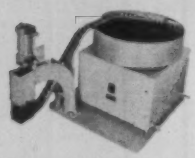
A-F *Engineered* Conveyors

Custom Engineered Conveying Systems
Pre-Engineered Conveyors—Wheel, Trolley
Metal Cleaning and Processing Machines

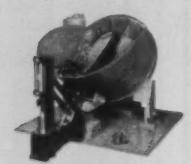
THE ALVEY-FERGUSON CO., 172 Disney Street, **CINCINNATI 9, OHIO** and Azusa, Cal.

Circle 717 on Page 17





VIBRATORY FEEDER for light, fragile or highly finished parts.



ROTARY FEEDER for high production feeding.

ROTARY HIGH SHELL FEEDER for maximum holding capacity.

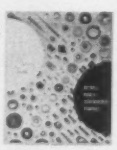
Shuffle and deal parts for automatic assembly with

DPS selective feeders

It takes fast, automatic feeding to satisfy the appetites of today's automatic assembly machines. And nowhere can you duplicate the range of equipment, the specialized experience in selective feeders offered by Detroit Power Screwdriver Company.

The most complete line in industry, DPS parts feeders include rotary, vibratory and elevator types. They handle any product from the tiniest of screws to assembly components the size of your fist . . . range in holding area from eighty cubic inches to 20 cubic feet.

DPS will welcome an invitation to analyze your assembly operations. If lagging production can be traced to inefficient feeding, the problem is as good as answered. Write for catalog on selective feeders.

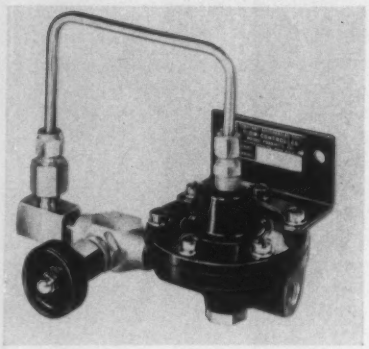


DETROIT POWER SCREWDRIVER COMPANY 15.036

2811 W. Fort St. • Detroit 16, Michigan

A Subsidiary of Link-Belt Company

Circle 718 on Page 17

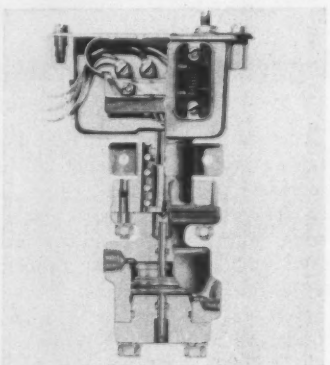


Low Flow Controller

Item 466

Applicable in gas chromotography, purge systems, pilot plants, and process-blending operations, controller can maintain a constant differential across a needle valve, capillary, or other restrictor—regardless of line pressure changes. Flow through an external restriction is a function of the opening and the drop across it. Since the controller holds a constant differential across the restriction, the flow varies only with changes in the opening. Model 63L can be used on liquid flows as low as 2 cc per min or on air flows as low as 30 scc per min. Rangeabilities of 500 to 1 or higher are possible. **Moore Products Co.**, H & Lycoming Streets, Philadelphia 24, Pa.

Circle 466 on Page 17



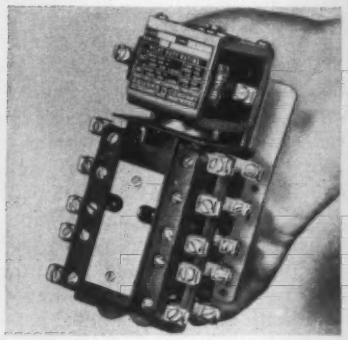
Pressure Switch

Item 467

Particularly suitable for filter installation, switch can sense a difference from 5 psi to 140 psi between two pressures. It is also applicable to oil systems ranging from 50 psi to 6000 psi working pres-

sure. When a filter becomes clogged, the switch senses the pressure difference across the filter's inlet and outlet and actuates a warning circuit. A sealed piston sensing element actuates an electric circuit upon increasing or decreasing of a predetermined pressure difference. The fixed actuation value of the unit is from 5 to 15 psi, depending on the working range of the system. **Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.

Circle 467 on Page 17

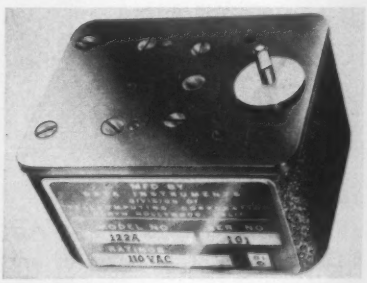


DC Magnetic Relay

Item 468

Designed for pilot duty applications on direct current control panels, relay is rated at 10 amp, with contact ratings of 125 va for 126 to 600 v and 250 va for 26 to 125 v. Models in the line are available with one to eight poles and as many as ten contacts. Standard coil voltages range from 115 to 250 v. **Square D Co.,** 4041 N Richards St., Milwaukee 12, Wis.

Circle 468 on Page 17



Stepping Motor

Item 469

Miniature stepping devices are designed to prevent double indexing during shock, vibration, or overvoltage. They are available in two

NEW WESTINGHOUSE LIMITEMP

Indicating Temperature Control

Limitemp* is a new, medium-priced control device that is ideal for monitoring or controlling temperatures between 100° F and 400° F. Controller may be used to indicate temperature and sound an alarm if temperature exceeds the preset point. A few applications include windings of large rotating machines, bearings, process temperatures and controlling temperatures in critical areas such as nuclear controls.

Limitemp employs magnetic and semiconductor elements of proven reliability; therefore, no vacuum tubes, no moving parts, no contacts . . . nothing to wear out.

LIMITEMP CHARACTERISTICS:
INPUT: 115 volts, 60 cycles OUTPUT: 24 volts d-c at 5 watts
TEMPERATURE RANGE: 100° F to 400° F—40° C to 200° C
INDICATION: Dual-scale calibrated meter and pilot light
ACCURACY: Setting ±1%, indicating ±2%, bandwidth 2% of range
COMPACT: 4 in. wide, 8½ in. high, 6 in. deep

GET ALL THE FACTS . . . write Westinghouse Electric Corporation, Director Systems Dept., 356 Collins Avenue, Pittsburgh 6, Pa. Complete information on the new Westinghouse Limitemp will be sent to you by return mail. J-01008

*Trade-Mark

YOU CAN BE SURE . . . IF IT'S Westinghouse

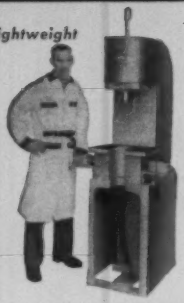
WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

Circle 719 on Page 17

AIR-HYDRAULICS

A NEW PRESS FOR LESS
15 TON—AIR HYDRAULIC

• Durable • Lightweight
• Compact

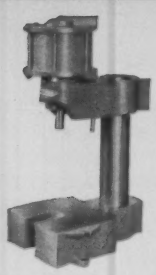


Model C-500. A versatile press with 8¼ inch throat. 6 inch stroke, 2 inch adjustment, equalized pressure full length whether feather-touch or full blow. 100 pound air line gets up to 21 tons delivery. Stand or bench installation. Moving parts protected in handsome housing. Adjustable speeds. Hand, foot or automatic controls. Simple, tireless and safe operation. Women like it. Long, trouble-free service. Easy to maintain and repair. For all kinds of materials. Thickness no problem. Rivets, flanges, broaches, stakes, crimps. Many other uses.

WRITE TODAY FOR INFORMATION REGARDING APPLICATION TO YOUR JOB . . . AND HOW LITTLE IT WILL COST YOU.

AIR-HYDRAULICS

DOUBLE ACTING • ADJUSTABLE
AIR PRESSES



PRECISION HONED
WITH CUSHIONED
CYLINDERS
TWO FAST
ACTING MODELS

For fast and steady small assembly work • riveting • punching • marking • staking. Equalized ram pressure in excess of 1 ton and ½ ton from 90 pound line. Double action gives lifting power almost matching ram pressure. Maintenance reduced by using "O" ring seals and bronze ram bushings. Head fully adjusts for proper stroke length and accurate die-setting. Extra heavy ram guide.

FOR LOW COST APPLICATION TO YOUR JOB—WRITE

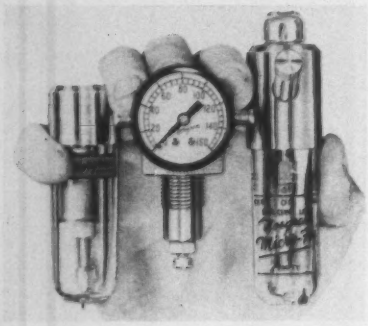
AIR-HYDRAULICS

299 HUPP AVENUE
JACKSON, MICHIGAN

Circle 720 on Page 17

models; a motor (designated MotoStep) and a motor with a switch (designated MotoSwitch). Both models are furnished in unidirectional and bidirectional units. The bidirectional feature is accomplished through the use of two identical stepping motors driving the same shaft in opposite directions. The output shaft is rotated 36 degrees for each input impulse at rates up to 40 steps per second. The units are rated for 24, 48, and 90 v dc with a maximum input power rating of 12 w, or 110 v ac at 15 w maximum. **Data Instruments Div., Telecomputing Corp.**, 12838 Saticoy St., North Hollywood, Calif.

Circle 469 on Page 17



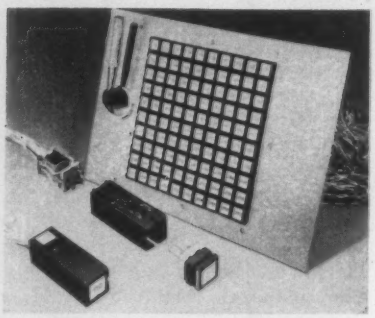
Airline Control

Item 470

Combination air filter, pressure regulator, and lubricator provides complete processing of compressed air for service to air cylinders, air chucks, air tools, bearings, and other machine components. Models are available for air flows from 0.05 to 20 cfm in either ⅛ or ¼-inch pipe installations.

The air filter removes corrosive liquids and abrasive solids from the air stream, preventing damage by these contaminants to connected air equipment. Filter features a transparent reservoir, directional air inlet, quiet zone, and sintered metal filter element. The regulator is adjustable over a pressure range of 5 to 100 psi. The lubricator has a controlled oil delivery and transparent oil reservoir and oil feed dome for 360-degree visibility of oil feed rate. Maximum line pressure is 150 psi; maximum regulated pressure 100 psi; and maximum operating temperature 120 F. **C. A. Norgren Co.**, Englewood, Colo.

Circle 470 on Page 17

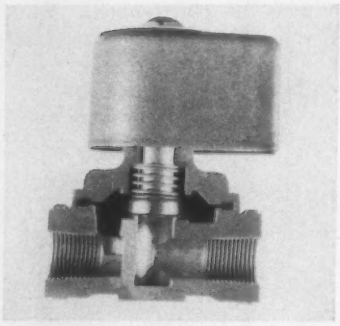


Lighted Pushbutton

Item 471

Lighted pushbutton switch features two bulbs, two switches, and mechanical interlocking. The two bulbs can be of different colors and each can indicate two functions by using steady or flashing light. Switch also has a button baffle which permits monitoring of up to six conditions: Using steady and flashing color on left half of button, different color steady or flashing on right half of button, and simultaneous steady or flashing color on both halves. The entire button and light assembly is removable from the front of the panel for relamping. Each switch is spdt, rated for 6 amp at 125/250 v ac; 3 amp at 30 v dc inductive; 6 amp at 30 v dc resistive. **Electrosnap Corp.**, 4218 W. Lake St., Chicago 24, Ill.

Circle 471 on Page 17



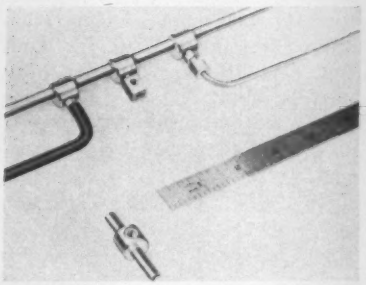
Solenoid Valve

Item 472

Designed to be mounted in any position, direct lift 2-way valve can control steam, air, gas, light oil, water, and other noncorrosive liquids and gases. Maximum temperature is 212 F, or 260 F for steam; pressure range is up to 20 psi. When supplied for temperatures to 212 F, Buna N discs and O-rings are used.

When supplied for temperatures over 212 F, insulated coils and high temperature discs and O-rings are used. Valve has a forged brass body and bonnet, stainless steel core and spring. It is available in a 5/16-inch orifice in either ⅜-inch or ½-inch connections. **Automatic Switch Co.**, Florham Park, N. J.

Circle 472 on Page 17



Miniature Tube Fitting

Item 473

Copper tubing fitting can be installed anywhere along the line to provide outlets wherever they are needed. To use, the beads are strung into position and sweat soldered; holes are drilled, or punctured in the tubing through the 10-32 ports; and chips are blown out. The tubing can also be used to sweat joint additional pieces of tubing together or where tubing must be cut to position outlet. It is available in two sizes; for ¼-inch OD tubing or 5/16-inch OD tubing. **Clippard Instrument Laboratory Inc.**, 7390-E Colerain Rd., Cincinnati 39, Ohio.

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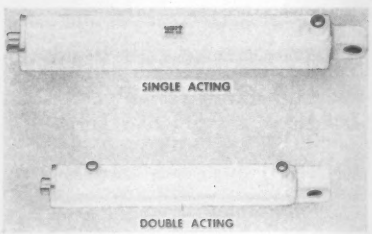


Hydraulic Cylinders

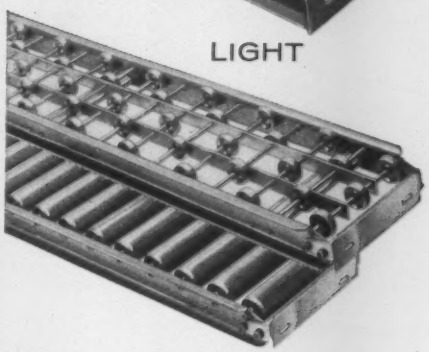
Item 474

Line of single and double acting cylinders is designed for both oil and air operation. The cylinders are suitable for use on machine tools, benders, hoists, lifts, presses,

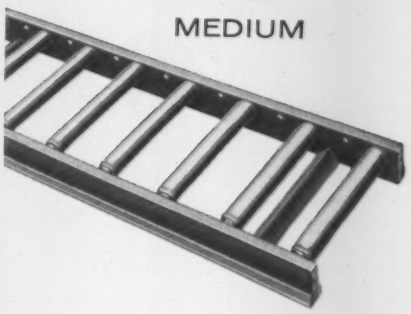
Only BUSCHMAN *has it!*

IN-STOCK *delivery on a* COMPLETE *range of roller & wheel conveyors*

LIGHT



MEDIUM



HEAVY

For fast delivery Buschman has available and in stock all three types of gravity conveyors, light, medium and heavy duty. Completely adequate for a wide range of handling applications.

No. 138 Light Duty
For low cost carton and package handling. Rust resistant rollers, available in 12" and 18" widths.

Medium Duty
Gravity wheel or roller conveyor in 12", 15" and 18" widths, steel or aluminum, and featuring the QUICK-EEZ Coupling.

No. 190 Heavy Duty
Roller available in 15", 19" and 25" widths for high capacity handling.

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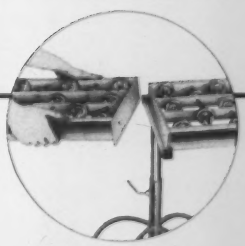


And, set-up is a snap with Buschman Portable Conveyors. Both ends are the same — an exclusive Buschman advantage.

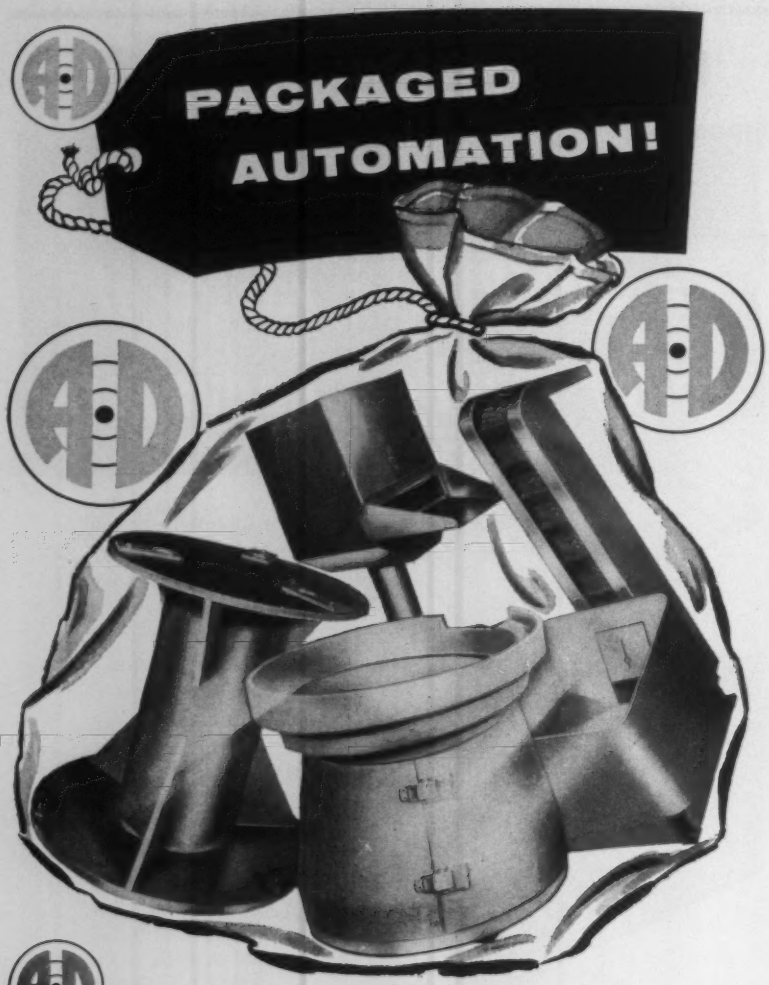
Every Way Better

E W B

THE E. W. BUSCHMAN CO.
4551 Clifton Avenue, Cincinnati 32, Ohio
C-355-EWB

CONVEYORS FOR EVERY INDUSTRY

Circle 721 on Page 17



Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.

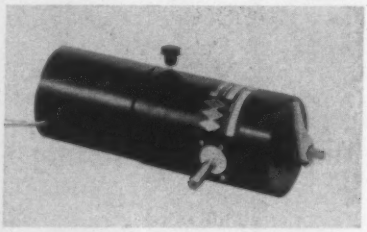
You can depend on the proven talents at AUTOMATION DEVICES, INC.—enlist their help. Write today for the informative bulletin on "Packaged Automation."

PEECO & VFC DIVISIONS . . . TWO GREAT NAMES IN PARTS FEEDING

AUTOMATION DEVICES INC.
ERIE, PENNSYLVANIA

and control mechanisms. The hard chrome plated piston rods are designed to eliminate corrosion and withstand heavy side loads without deforming. Molded wipers are used to prevent abrasive materials from entering and being carried through the entire hydraulic line. The walls of the cylinder tube are constructed to withstand high surge pressures and prevent side strain distortion. Units are available in bore sizes from 1½ to 6 inches, for operation at pressures up to 2500 psi. **Unit Mfg. Co.**, 18 W. 26th St., Minneapolis, Minn.

Circle 474 on Page 17



Miniature Speed Drive

Item 475

Applicable on actuators, computers, recorders, and integrators, variable speed drive is small enough to fit in the palm of a hand. It has a frequency response equivalent to a hydraulic system. A maximum torque of two inch-ounces on the control shaft of the drive changes speed from full forward to full reverse on 0.05 second. Output torque is constant and the efficiency is between 85 and 95 per cent. With the addition of a calibrated dial, positive speed adjustment can be obtained. A flexible push-pull cable for manual remote control and solenoid control for electrical remote control is also available. **Humphrey Products Div., Humphrey Inc.**, 3794 Rosecrans St., San Diego 10, Calif.

Circle 475 on Page 17

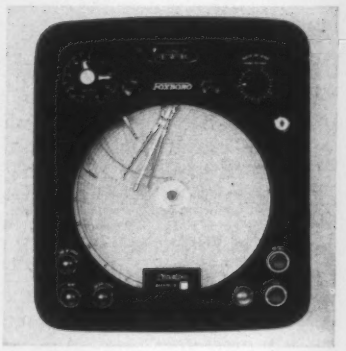
Solenoid Valve

Item 476

Line of explosion-proof and splash-proof solenoid valves is suitable for automatic or remote control of flow of water, brine, oil, solvents, gas, or air. Some of the valves in the line are made for hydraulic

control applications and others for the control of air or gases under pressure or vacuum. Fluid temperatures up to 212 F and pressures ranging to 300 psi can be handled. The valves are available in pipe sizes from ¼ to 3 inches, with a capacity equal to the pipe size. **Magnatrol Valve Corp.**, Fifth Avenue, Hawthorne, N. J.

Circle 476 on Page 17

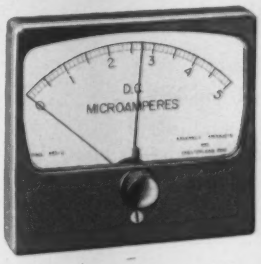


Cycle Controller

Item 477

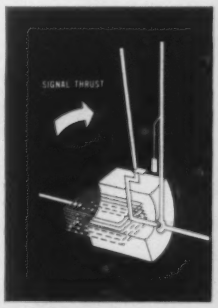
Instrument features an automatic rinse control for dye kettle operations. The rinse valve automatically opens to flush away spent dyestuffs and chemicals and maintain rinsing until the end of the cycle. Adjustable settings on the front of the instrument control the schedule. The adjustable settings are: The starting temperature, the desired rate of temperature rise, the dyeing temperature, the holding time, the rate of cooling, and the rinse. The dyeing program is controlled by pneumatically operating steam, water, and rinse control valves at variable time and temperature values. Varicolored signal lights indicate each stage of the dyeing operation and a 12-inch circular chart pro-

10,000,000 PERFECT OPERATIONS: reliability . . . achieved by the remarkable A.P.I. meter-relay

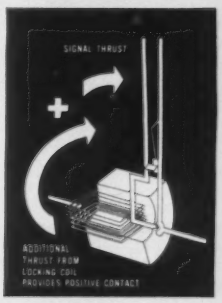


Suitable for any electrically-measurable variable, the A.P.I. meter-relay gives you sensitive monitoring, reliable control, combined in a single compact unit. It is an essentially simple instrument, yet a highly accurate and dependable one.

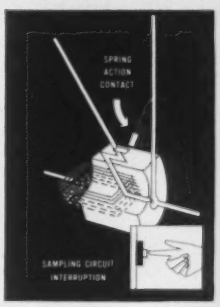
HERE'S HOW IT WORKS



1. Basically, the A.P.I. meter-relay is an indicating meter with built-in contacts. One contact is on the moving (signal-indicating) pointer; the other, on the adjustable (set-point) pointer. The indicating pointer is a free-moving element. The meter-relay has the high sensitivity inherent in a well-designed D'Arsonval movement.



2. At the instant of contact, a locking coil, wound integrally with the armature coil, supplements the torque developed in the meter movement. It is this locking coil — exclusively featured by A.P.I. — that assures positive contact every time. It holds the contacts together, maintains firm pressure to provide a good control circuit.



3. "Making" of the contacts loads the flexure spring on the set-point contact arm. When the contacts are released, they are immediately pushed apart by the force of the spring-loaded arm. There is no teasing or sticking; the break is decisive. Wiping action keeps contacting surfaces clean.

If you need fully-reliable, stable control at a practical cost, you ought to have a look at our Catalog 4E. A copy is yours on request.

api **ASSEMBLY PRODUCTS, INC.**
Chesterland 27, Ohio

S-A, 1905

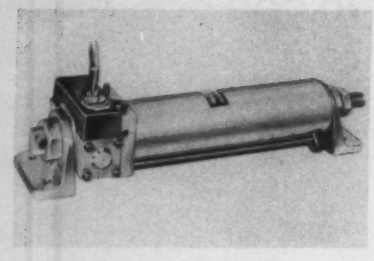
Circle 723 on Page 17

vides a permanent record of the cycle for quality control and future duplication of the dyeing schedule. **Foxboro Co.**, Foxboro, Mass.

Circle 477 on Page 17

Air Cylinder

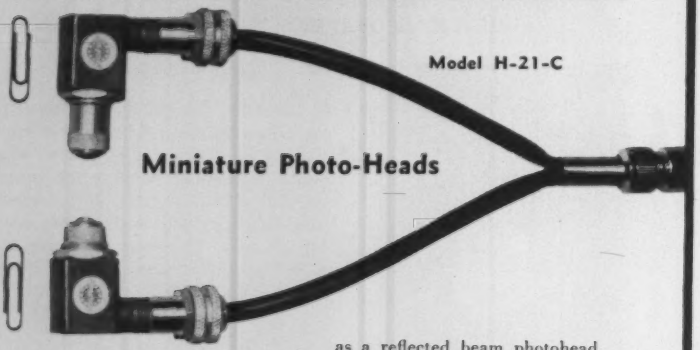
Item 478



Line of air cylinders features built-in directional and exhaust speed control valves. Bore sizes are 1½, 2, and 3-inch. Directional control valve actuation can be solenoid, remote pilot pressure, button-bleeder, or combination solenoid-button bleeder. The solenoid-operated models feature single conduit connection for double solenoid units, and plug-in solenoid coils which permit replacement or changing to different voltages without disconnecting the wiring or piping. All mountings are interchangeable. **Modernair Corp.**, 400 Preda St., San Leandro, Calif.

Circle 478 on Page 17

POST DECITRON ELECTRONIC PRODUCTS



Post's Miniature Photo-heads solve the problem of mounting a sensing device in a limited area. Hardly larger than a standard paper clip, these photosensitive, semi-conductors may also be used as a reflected beam photohead.

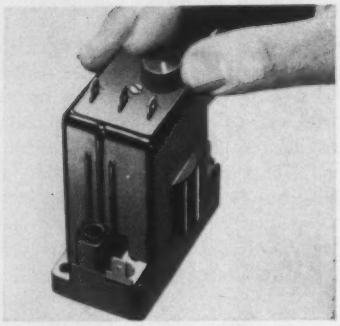
Average light source life is 5,000 hours . . . designed for industrial use. Alignment brackets to insure proper relation of light source and receiver are also available.

Decitron

POST ELECTRONICS

Division of Post Machinery Co. | 163 Elliott St., Beverly, Mass.

Circle 724 on Page 17



Time-Delay Relay

Item 479

An electronic timing system is used in time-delay relay. It is designed to provide fast switching action, instantaneous reset, high timing accuracy, and full reproducibility of the time-delay period during rapid recycling. An R-C network serves as a time pilot for the control circuit, which in turn operates a high-speed electromechanical switching unit. Accuracy is within ±10 per cent of the specified time delay. Temperature effects are negligible over the operating range of zero to 130 F.

Relay is available with either a fixed or adjustable time delay period of from 1.5 to 30 seconds. Standard delay periods are 1.5, 5, 10, 15, 20, and 30 seconds. Switching action is single-pole, double-throw. Contact capacity on resistive loads is 2 amps at 120 v ac; 1 amp at 250 v ac; and 0.5 amp at 50 v dc. **Heinemann Electric Co.**, 472 Plum St., Trenton 2, N. J.

Circle 479 on Page 17

ACRO WELDER MFG. CO.

MILWAUKEE

WELDING ENGINEERS

MACHINERY BUILDERS

ESTABLISHED 1936

Circle 725 on Page 17

Limit Switch

Item 480

Device features integrally molded mounting ears for mounting to the back of a panel or other surface

SPLICE DIGITAL TAPE IN 2 SECONDS

Now splice all 5 to 8 channel paper tapes as well as all ½" to 1¼" mylar or acetate base magnetic tapes perfectly IN TWO SECONDS with the miracle Presto-Splicer.

Permanent butt-weld or overlap splice lasts under all use conditions because the splice is actually electrically fused! Sticky pastes, messy cements and brushes are entirely eliminated. After splicing, tape maintains original condition — data is neither destroyed nor distorted . . . with the new information accurately inserted.

Write for illustrated Brochure.

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Circle 726 on Page 17

AUTOMATION

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Hydraulic Control of Automatic Machinery

SYNTHESIS OF SYSTEMS
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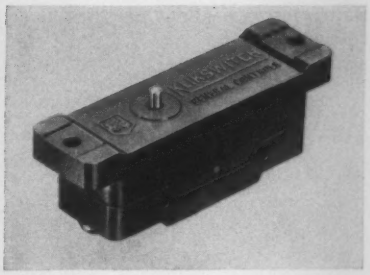


in a fixed relation to an actuating mechanism. It is available with SPDT or SPST normally closed contacts rated for 8 amp at 115 v ac, noninductive load. It requires 14.25 oz force to operate; and the release occurs automatically when the force is reduced to 6.34 oz. Operation pretravel is 0.021-inch maximum; differential, 0.0035-inch maximum; overtravel, 0.005 inch. **Automation Div., General Controls**, 8078B McCormick Blvd., Skokie, Ill.

Circle 480 on Page 17

Diaphragm Control Valve

Item 481

Suitable for use in air, oil, or vacuum circuits, diaphragm operated control valve is designed for actuation by a 3-way pilot valve, instrument control, cycle controller, or process timer. The valve is designed for 20 to 60 psi air actuation, 15 psi instrument pressure, or intermittent actuation pressures up to 125 psi. The diaphragm operated end section can be used with any combination of 2, 3, or 4-way valve bodies and end sections. A range of mounting styles with port sizes from ¼ through 1-inch is available. **Valvair Corp.**, 454 Morgan Ave., Akron 11, Ohio.

Circle 481 on Page 17

a CASE summer short course in NUMERICAL FEEDBACK CONTROL

Case Institute announces a two-week short course in Numerical Feedback Control. This course is directed toward both industrial and military personnel whose technical activity is concerned with guidance, control, or the generation of control function from discrete and/or discontinuous numerical intelligence. The course will be conducted at Case Institute of Technology, Cleveland, Ohio, July 6 to July 17, 1959. Inquiries should be addressed to: Mrs. Jean Yates, Office of Special Programs,

CASE INSTITUTE OF TECHNOLOGY
UNIVERSITY CIRCLE
CLEVELAND 6, OHIO

Circle 727 on Page 17

PRESSURE SWITCHES for twice-a-second or twice-a-year operation!

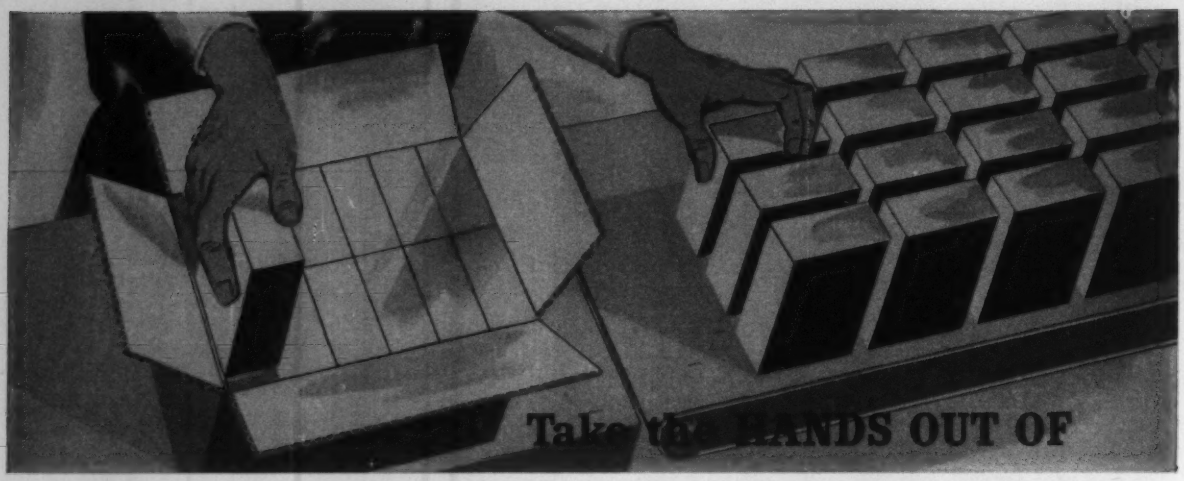
An Oil-Dyne pressure switch has repeatability—it will function properly every time, whether it operates several times a second—or once every six months! Liberal use of low-friction materials and a completely new (patent applied for) design that eliminates all contact between O ring and cylinder walls combine to keep piston from sticking—assures perfect operation every time, any time. 50-5000 psi, explosion-proof. Single and duplex models. For hydraulic fluids and gases (freon, oxygen, etc.). Write for illustrated brochure.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

- PUMPS
- CYLINDERS
- PRESSURE SWITCHES
- VALVES
- ACCESSORIES

OIL-DYNE INC.
2115E West Marquette Road, Chicago 36, Ill.

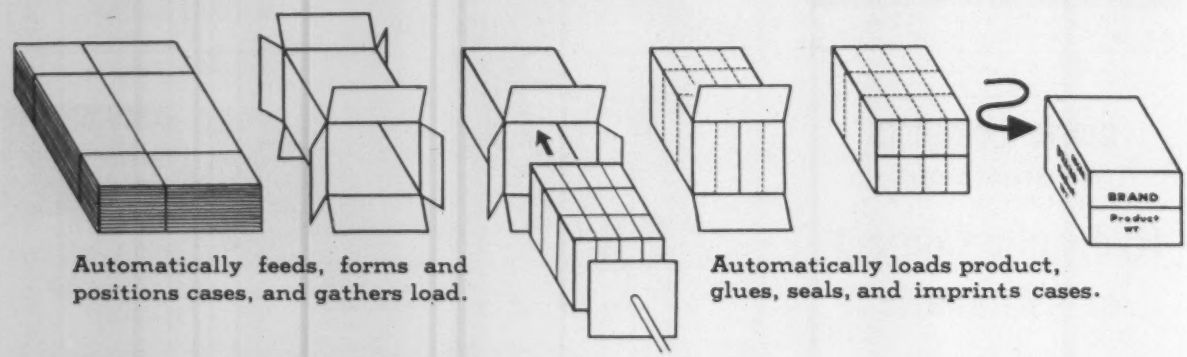
Circle 728 on Page 17



Product Handling

let Packomatic® equipment do any or all your casing operations AUTOMATICALLY:

T.M. Reg. U. S. Pat. Off.



Automatically feeds, forms and positions cases, and gathers load.

Automatically loads product, glues, seals, and imprints cases.

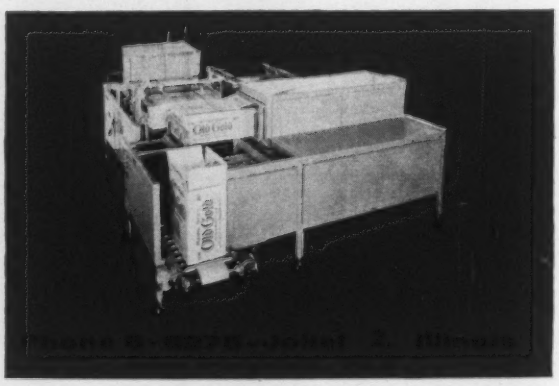
For casing round, square, rectangular, or free-form packages of virtually any size.

If you employ even one person per shift to hand-form cases, or to hand-pack, hand-seal or hand-imprint them, then it can pay you to install Packomatic equipment. And if you employ two or more people the savings can increase proportionately. Even a **complete** automated Packomatic line requires only a minute or two of attention at infrequent intervals to match the output of a dozen pair of hands. And in addition to reducing your direct labor production costs Packomatic can, by utilizing end-opening shipping cases, reduce paper-board costs up to 25%. And mechanically end loaded cases are stronger too, because the flaps give added resistance to weight and shock. In addition, they stack better because their uniformly flat sides enables keying of pallet loads. Write, wire or phone us for facts on how to reduce your casing costs.

PACKOMATICS include Case Sealers • Case Opener-Loaders • Case Packer-Gluers • Case Imprinters • Bale Sealers • Automatic Equipment for Shelf Carton Making, Feeding, Filling and Closing • Round Paper Can Mfg. Equipment

J. L. FERGUSON COMPANY - Box 1226

FOR EXAMPLE: This Packomatic machine at the P. Lorillard Co. automatically forms and positions cases, end-loads regular or king-size cartons of Old Gold cigarettes (60 cartons per case) and up-ends cases for sealing — at the rate of 400 cartons per minute, or nearly 5 million smokes per hour.



catalogs and literature

Latest automation information. For copies use card on page 17.

Automatic Tracing Lathe

Jones & Lamson Machine Co., Springfield, Vt.—8 *page bulletin*—An automatic tracing lathe, designated Model 30, is the subject of Bulletin CO5810. The automatic tracing cycle is explained as are components such as the bed, the headstock, the tailstock, and the stylus and template. Functions and advantages of three available rear slides are also discussed.

Circle 482 on Page 17

Repair Parts Manufacture

LaSalle Steel Co., P.O. Box 6800-A, Chicago 80, Ill.—24 *page handbook*—Maintenance and repair part problems are discussed in Bulletin 21 entitled, "How to Make Your Own Machine and Repair Parts Quicker and Easier." Manual covers care and troubleshooting of machine and equipment—and machining and welding techniques. Various case histories are noted and charts list drill hole tolerances and grinding limits for cylindrical parts.

Circle 483 on Page 17

Pressure Elements

Fischer & Porter Co., 845 Jacksonville Rd., Hatboro, Pa.—8 *page bulletin*—Line of pressure elements such as bellows, bourdon tubes, and liquid filled types are described in Bulletin 11P-1000. Specifications are given on elements suitable for pressure ranges between the limits of 30 inches Hg vacuum and 5000 psig.

Circle 484 on Page 17

Rotary Gear Finishers

Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.—4 *page pamphlet*—Bulletin 870-A-58 describes two rotary external gear finishing machines which shave gears by cutting away metal in tiny, hair-like chips with a serrated rotary cutter to provide a high surface finish. Illustrations show the three gear shaving methods—the underpass, modified underpass, and transverse. Also included are notes on optional equipment.

Circle 485 on Page 17

Turret Type Machines

Burg Tool Mfg. Co. Inc., 15001 S. Figueroa St., Gardena, Calif.—4 *page pamphlet*—Machines for turret type drilling, tapping, and boring operations are outlined. The types of machines covered include: Automatic hydraulic, radial type, numerically tape controlled, and special type turret drills. Data on floating tool holders are given.

Circle 486 on Page 17

Collapsible Containers

Container Products Dept., U. S. Rubber Co., Providence 1, R. I.—16 *page booklet*—Collapsible containers for the handling, shipping, and storage of bulk materials are described in Bulletin CP-58-22. Features and construction of the containers are noted. The filling operation and how the product is protected from contamination is explained—as well as the method of loading and unloading containers. Charts list physical specifications, typical loadings, and loading capacities.

Circle 487 on Page 17

Electric Production Tools

Black & Webster Inc., 445 Watertown St., Newton 58, Mass.—12 *page bulletin*—Data are contained in Bulletin 75 on line of solenoid-operated tools suitable for riveting, staking, crimping, swaging, punching, and marking operations. Included in the line are impact hammers, punches, stakers, and indexing tables. One section covers special automatic production machinery.

Circle 488 on Page 17

AC Motors

Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio—12 *page booklet*—Data are given in Bulletin B-2103-4 on ac motors ranging from 1 through 200 hp. Frame selection tables and dimensions for standard frames and mechanical modifications for all frame sizes from 182 through 6085 are included. Illustrations show special-purpose motors which are suitable for use in unusual temperatures or atmospheres.

Circle 489 on Page 17

Control Centers

Control Design & Fabricate Inc., 30725 Twelve Mile Rd., Farmington, Mich.—4 *page pamphlet*—Control centers for all types of automatic systems and machinery are described in Bulletin CO-101. Illustrations show models used in material handling systems, order-filling systems in warehouses, and loading stations for storage lines.

Circle 490 on Page 17

Wheel & Roller Conveyors

Mathews Conveyer Co., Ellwood City, Pa.—68 *page catalog*—Data are contained in Catalog 158 on heavy-duty wheel conveyors and roller conveyors ranging in diameter from 1⅛ to 6½ inches, and in capacity from 60 to 16,000 lb. Specifications and load ratings are given and sketches show the dimensions for various frames. Also included are illustrations of different applications.

Circle 491 on Page 17

Magnetic Servo Amplifiers

Magnetic Amplifiers Inc., 632 Tinton Ave., New York 55, N. Y.— 8 *page bulletin*—Servo amplifiers applicable on automatic milling machines, lathes, and jig boring machines are described in Bulletin S-961. Data are given on 1 to 4 stage systems, using ac or dc inputs with transistor-magnetic or all magnetic configurations for 60 and 400 cps systems. Recommended servo motor loads for system applications having power ratings from 85 to 2500 w are also given.

Circle 492 on Page 17

Corrugated Packaging

Hinde & Dauch, 407 Decature St., Sandusky, Ohio—8 *page bulletin*—Illustrative booklet shows the step-by-step process of designing a corrugated shipping box for a specific product. The different factors to be considered are noted and examples of counter displays are given. Also shown is an automatic machine which performs every step from set-up to sealing in the packaging of industrial wax.

Circle 493 on Page 17

Multispindle Boring

Heald Machine Co., 7 New Bond St., Worcester 6, Mass.—16 *page booklet*—Booklet entitled "Production Tips" discusses how various operations such as straight and taper boring, straight and taper turning, facing, chamfering, grooving diameters and faces, and reaming, can be combined for automatic machining on unit-type Model O Bore-matic. Fourteen different examples illustrate how holes are

drilled, reamed, bored, counter bored and faced at one loading. Included are examples of how connecting rods and pistons are machined simultaneously; and how commutator assemblies are rough, semifinish and finish bored six at a time. Also explained are how special attachments can be used for contour or spherical boring or turning and slot milling.

Circle 494 on Page 17

Automatic Bag Ejector

Richardson Scale Co., Clifton, N. J.—4 page pamphlet—An automatic bag ejector, which transfers filled bags from a bag table onto a bag sewing conveyor belt, is the subject of Bulletin 2549A. Components in the system, which includes a scale, a pneumatic auger packer, a bag ejector, and a bag sewing conveyor, are described. Also discussed is the step-by-step procedure from the weighing to the sewing operation.

Circle 495 on Page 17

Rotary Components

Kearfott Co. Inc., Little Falls, N. J.—16 page booklet—Data are given on line of rotary electromechanical components used for industrial and other types of servo systems. The types of units described are: Servomotors, tachometers and motor-tachometer generators, and synchros. Dimensional drawings of the different units are given along with performance characteristics.

Circle 496 on Page 17

Hydraulic Operating Valves

Homestead Valve Mfg. Co., Coraopolis, Pa.—20 page booklet—Line of single piston type hydraulic operating valves is described in Bulletin 39-6. The valves are available in sizes of ½ to 2-inch in multiple port types and up to 6 inches in two-way or spray valve type. The principle of operation is explained and illustrated by photos. Charts list capacities and piston speed and flow.

Circle 497 on Page 17

Gas Flow Computing Systems

Foxboro Co., Foxboro, Mass.—3 bulletins—Gas flow computers are described which provide continuous, up-to-the-minute flow data for gas dispatching. Data are given on the natural gas flow computing system using the single meter run computer; the multiple meter run computer; and the modified multiple meter run computer. Schematic drawings illustrate the different systems and tables list flow capacities.

Circle 498 on Page 17

Electronic Weighing

Streeter-Amet Co., Grayslake, Ill.—2 bulletins—Basic elements of electronic weighing and remote recording are discussed. The development, theory of operation, types of load cells, and mechanical instrumentation are explained. Second bulletin describes an electronic weighing scale suitable for use on cranes, trucks, hoppers, or tanks. Data are also given on various desk and cabinet recorders and other accessories.

Circle 499 on Page 17

Fly Ash Handling

Fuller Co., Catasauqua, Pa.—16 page booklet—Methods of collecting and handling fly ash with pneumatic conveyors is discussed in Bulletin FF-49-1. Units used in this system include a fluidizing conveyor, pumping system, and rotary compressor. Other related equipment such as control panels, feeders, rotary bin discharge valves, material level indicators, and pipeline diverting valves are also described. Also included are isometric drawings of handling equipment and schematic diagrams of installed systems.

Circle 500 on Page 17

Temperature Controls

Partlow Corp., 509 Campion Rd., New Hartford, N. Y.—4 page pamphlet—Two pneumatic operated temperature controls for controlling a variety of heating appliances are outlined. The units are: A recording pneumatic temperature control and an indicating temperature control. A chart lists the ten optional temperature ranges available. Material specifications are also mentioned.

Circle 501 on Page 17

Motion Position Transmitter

Brooks Rotameter Co., Box 432, Lansdale, Pa.—12 page bulletin—Building block construction of the transmitters with standardized metering elements and interchangeable extensions are explained in Bulletin 170. Notes and performance data on the different types of units in the series are given and schematic drawings show the relationship of the various components.

Circle 502 on Page 17

Magnetic Clutches

Fawick Airflex Div., Fawick Corp., 9910 Clinton Rd., Cleveland 11, Ohio—12 page booklet—Magnetic clutches and their application to automatic machinery are discussed in Volume 3, No. 1 of company publication. The different types of magnetic clutches are explained and performance charts show engagement, disengagement, and heat dissipation characteristics. The booklet also discusses clutch control for applications where safety is important.

Circle 503 on Page 17

Milling Machine

Consolidated Machine Tool Div., Farrel-Birmingham Co. Inc., 565 Blossom Rd., Rochester 10, N. Y.—32 page handbook—Line of production-line milling machines is described and illustrated in Bulletin 675-A. Some of the styles are: Straight-line, vertical openside, sliding head, shuttle type, rise and fall, rotary index, transfer, planer, and traveling column. Other machine tools manufactured by Consolidated Machine Tool Div. are also mentioned.

Circle 504 on Page 17

Conveyor Belting

Voss Belting & Specialty Co., 5645 N. Ravenswood Ave., Chicago 26, Ill.—8 page bulletin—Data are given on belting for conveying and power transmission which can be used for manufacturing and food processing equipment. The belting is constructed of materials such as rubber and neoprene. Formulas are given for determining the length of belting required for an application.

Circle 505 on Page 17

Bearing Lubrication

Miniature Precision Bearings Inc., Precision Park, Keene, N. H.—25 page handbook—The lubrication of miniature instrument bearings is the subject of Bulletin 5810. Manual includes a discussion on oil and grease lubrication, properties of lubricating oils and greases, and special lubricants. Data on various types and brands of oils and greases are given. Blending charts and nomographs are also included.

Circle 506 on Page 17

Gage Logging System

General Electric Co., Computer Dept., Phoenix, Ariz.—8 page bulletin—A gage logging system, designated Model GE 309, is the subject of Bulletin GEA-6873. From four to eight distinct inputs from sensing equipment on the process can be accepted, totalized, and recorded in typewritten form. The building-block construction is explained and details of operation are given.

Circle 507 on Page 17

Pneumatic Accessories

Arrow Tools Inc., 1972 S. Kostner Ave., Chicago 23, Ill.—16 page booklet—Pneumatic accessories such as line filters, pressure regulators, automatic drain traps, and jet mist generators are described in Catalog 50. Data are given on an automatic filling lubricator system which can serve lubricators in groups or in combination with filters and regulators of the same or mixed pipe sizes. Also covered are accessories such as bowl mounting bracket clamps, regulator mounting brackets, and pressure gages.

Circle 508 on Page 17

V-Belt Drives

Dodge Mfg. Corp., Mishawaka, Ind.—44 page catalog—A line of V-belt drives, said to be smaller than conventional V-belt drives, is described in Bulletin A-695. Advantages of these drives are discussed and notes are given for selecting the proper drive. Engineering drawings are included and tables list horsepower capacities, belt speeds, center distances, and sheave diameters. Also covered are the construction and specifications of sheaves.

Circle 509 on Page 17

Pushbutton Switch Devices

Micro Switch, Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—20 page booklet—Line of lighted indicator and pushbutton switch devices, designed for control panels, is described in Catalog 67. Construction of the parts which snap together to form various combinations is explained. Data are given on lighting, indication, mounting, and arrangements. One section discusses the role human engineering principles play in lighted display and control.

Circle 510 on Page 17

Industrial Seals

Minnesota Rubber Co., 3630 *Wooddale Ave., Minneapolis* 16, *Minn.*— *24 page catalog*—Data, such as size numbers and dimensions of industrial O-rings and company's Quad ring, are given. The sizes are cross indexed for comparison with many of the dimensional specifications. Suggestions for selecting and installing the different seals are also given. Reference charts cover aeronautical material specifications, SAE-ASTM material specifications, and MIL-R-5847C specifications.

Circle 511 on Page 17

Control Valves

Hunt Valve Co., Salem, Ohio.—*4 page pamphlet*—Solenoid, lever, or ball actuated valves are outlined in Bulletin 581. Design of the "slim line" valve (1-inch thick, 3 inches wide) permits the unit to be manifolded for multiple operation. Maintenance features are also mentioned.

Circle 512 on Page 17

Amplifying Hydraulic Relay

Hydraulic Controls Div., North American Mfg. Co., 4455 E. 71st St., Cleveland 5, Ohio—4 page pamphlet—Data are contained in Bulletin 1-001 on a hydraulic relay which can be used for web guiding, controlling pressure, flow or proportioning control, and positioning or locating. The jet principle, which is the heart of the relay, is explained, and a cutaway photo shows the parts that make up the unit. Performance curves are shown for various models.

Circle 513 on Page 17

Quick-Seal Couplings

Titeflex Inc., Hendee St., Springfield 4, Mass.—*20 page booklet*—Data on line of couplings for hydraulic and pneumatic applications are given in Bulletin QSR 58. Design of the three types of couplings—straight-through, single check-valve, and double check-valve—is explained. Cross-section drawings show the features of the couplings and a chart lists information for selecting the seals for couplings in various temperature ranges.

Circle 514 on Page 17

Automatic Assembly Machines

Ferguson Machine Corp., 7818 *Maplewood Industrial Court, St. Louis* 17, *Mo.* —*8 page bulletin*—Data are given in Bulletin 601 on automatic assembly machines and methods of tooling machines with slow cyclic rates to produce multiple assemblies simultaneously. The design of the equipment and how it can be adapted for the production of different items are explained. Bulletin also discusses such subjects as the combining of manual and automatic methods as an interim step towards full automation; and the integration of parts manufacture and assembly on a single machine.

Circle 515 on Page 17

Temperature Controls

Fenwal Inc., Pleasant St., Ashland, Mass. —*8 page bulletin*—Data are contained in Bulletin MC-177 on nonindicating temperature controllers and mounting walls.

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Circle 730 on Page 17

The thermostats described are suitable for use in temperatures ranging from −100 to 600 F and 200 to 1,500 F. Features are explained and charts list available modifications.

Circle 516 on Page 17

Conveyor Equipment

Materials Handling Dept., Industrial Div., Continental Gin Co., Birmingham 2, Ala.—88 *page catalog*—Data are given in Catalog ID-591 on belt conveyor equipment and the elements necessary to build a belt conveyor. Types of units described are: Rubber disc impact and return idlers, self-aligning idlers, light-duty idlers, heavy-duty idlers, motor propelled trippers, wing type pulleys, belt scrapers, pillow blocks, and self-contained apron feeders. The procedure for designing a belt conveyor is outlined with charts, tables, and diagrams included for reference.

Circle 517 on Page 17

Circuit Testing System

Electronics Div., Dit-Mco Inc., 911 Broadway, Kansas City 5, Mo.—64 *page handbook*—Circuit testing procedures and methods of locating, recording, and correcting errors are explained in handbook. A suggested test system flow diagram and an outline for setting up a test system are given. Also included are pictures of types of circuit errors detected and located by use of the system.

Circle 518 on Page 17

Solenoid Valves

Atkomatic Valve Co., 545 W. Abbott St., Indianapolis, Ind.—36 *page catalog*—Data are contained in Catalog 444 on line of electrically operated valves for air, gas, liquids, or steam. More than 200 valves, with pressure ratings ranging from zero to 10,000 psi and temperatures from −300 to 500 F, are covered. Numerous solenoid valve coil charts and flow charts are given. Cutaway drawings identify valve parts and illustrate valve operation.

Circle 519 on Page 17

Oil-Free Compressors

Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.—12 *page booklet*—Data are given in Bulletin A-44 on heavy duty industrial compressors ranging from 95.6 to 939 cfm. Design of the T-block compression rings is explained, as are the two types of construction of the compressor. Also included are notes on some of the accessories available.

Circle 520 on Page 17

Digital Instruments

Non-Linear Systems Inc., Del Mar, Calif.—6 *page pamphlet*—Three, four, and five digit instruments for continuous automatic measuring and recording of dc and ac voltages, voltage ratio, and resistance are described. A block diagram shows the different measuring functions that can be accomplished. Selection guides aid in choosing the best suited instrument for a specific application.

Circle 521 on Page 17

Electronic Controller

Controls Div., Hagan Chemicals & Controls Inc., Box 1346, Pittsburgh 30, Pa.—4 *page pamphlet*—Model CPM-1, an electronic temperature controller for electric heat treating furnaces, is the subject of Bulletin GE-60001. High level output signals from this unit are capable of controlling saturable reactors, heating elements, electropneumatic pilot valves, or valve positioners. Operating principle is explained, as is the temperature control, aided by sketches of installations.

Circle 522 on Page 17

Motor Drives

Falk Corp., Dept. 255, Box 492, Milwaukee 1, Wis.—28 *page catalog*—Line of speed reducer drives with coupled or integral motors from 1 through 75 hp is described in Bulletin 3100. Data are given on unit size and construction, overhung load and thrust capacities. Also included are notes on selecting the proper size and ratio of a unit and suggestions on using the Motoreducers for special applications.

Circle 523 on Page 17

Control System Calibration

Technique Associates Inc., 1413 N. Cornell Ave., Indianapolis 2, Ind.—16 *page booklet*—Details are given on how to calibrate types of temperature control systems. Emphasis is placed on the testing and calibration of control systems which use proportional currents for signal transmissions and telemetering. Data are included for three instruments—a combination potentiometer, signal source, and milliammeter; an automatic cold junction compensator; and a combination milliampere and millivoltage source.

Circle 524 on Page 17

Magnetic Controls

Furnas Electric Co., 1128 McKee St., Batavia, Ill.—2 *bulletins*—Magnetic contactors are described in two bulletins. Units for air conditioning and refrigeration are covered in Bulletin 41-B1. Coil characteristic data and outline dimensions are given. Bulletin 41-B2 describes contactors which are rated through 10 hp, 220 v and 15 hp, 550 v polyphase for across-the-line control of electric motors, heating and lighting loads.

Circle 525 on Page 17

Vertical Conveying Systems

Lamson Corp., Syracuse 1, N. Y.—4 *page pamphlet*—A combing vertical conveyor than can handle any load which can be moved on a roller type conveyor is described in Bulletin 205. Photos show the method of tying together horizontal floor conveyors in a multi-floor building into an integrated system. Other illustrations show different vertical conveyor applications.

Circle 526 on Page 17

Automatic Welding Machines

Dix Engineering Co. Inc., 1421 Dix Rd., Lincoln Park, Mich.—6 *page pamphlet*—Automatic welding machines are

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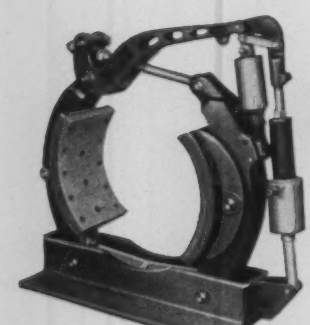

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Circle 731 on Page 17

outlined. Case histories describe various welding problems and data are given on the machines which solved the problem. Company's engineering staff and welding service is also explained.

Circle 527 on Page 17

Hydraulic Presses

Denison Engineering Div., American Brake Shoe Co., 1160 Dublin Rd., Columbus 16, Ohio—4 page pamphlet—Hydraulic multipresses, ranging in capacities from 1-ton to 75-ton ram pressure are outlined in Bulletin 195-A. Styles include both bench and floor models. Accessories such as foil feed and marking, stock feed, index table, and touch control are also covered.

Circle 528 on Page 17

Control Panels

Oilgear Co., 1571A W. Pierce St., Milwaukee 4, Wis.—4 page pamphlet—Amplifier and control panels, designed for operating electrohydraulic servo systems, are described and illustrated in Bulletin 36400. Units covered are used for an electrohydraulic servo-controlled spray machine, a servo-controlled pump operation on an offshore drilling barge, and an electrohydraulic servo-controlled press brake.

Circle 529 on Page 17

Roller Conveyors

Standard Conveyor Co., North St. Paul 9, Minn.—24 page catalog—Roller and belt conveyors for handling packaged commodities such as filled bags, sacks, cartons, boxes, crates, lumber, and shingles are described in Bulletin 65. The types are: Gravity and live roller conveyors, portable belt conveyors, and horizontal and inclined belt conveyors. Illustrative examples of various applications are given and schematic drawings show typical elevation views of conveyors.

Circle 530 on Page 17

Disc Grinding

Besley-Welles Corp., South Beloit, Ill.—8 page bulletin—Double horizontal spindle disc grinder described in Bulletin DH4 is applicable for grinding parts such as bearing races, piston rings, gear blanks, or any parts with two flat surfaces. Data are given on the three-step abrasive change, automatic dressing and sizing, centralized one-shot lubrication, and the coolant system. A cut away drawing shows the features of the unit.

Circle 531 on Page 17

Millivoltmeters

Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Avenues, Philadelphia 44, Pa.—28 page catalog—Data are contained in Catalog C10-1 on line of indicating, controlling, and safety cut-off millivoltmeters. Design features, principle of operation, and the measuring elements are explained. Charts list specifications and dimensions.

Circle 532 on Page 17

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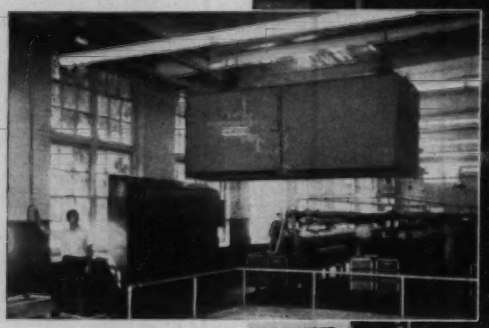
A Tramrail freight-carrying van leaving one building. Building doors open and close automatically. Tramrail track is high and above interference with railroad. The entire handling system is very safe.



Operator pushes wall button to start van on its way. Van rises until it reaches Tramrail carrier on track. Then carrier hauls van to building selected.

RAIN or shine, this Cleveland Tramrail system works without complaint. Inclement weather is of no concern, because no one has to go outside to operate this system.

The Tramrail freight-carrying van travels between buildings as directed by the touch of a pushbutton. It goes up and down grades and handles materials between different floor levels.

No regular operator is needed for this type of system. Usually the time required to dispatch loads is so little that production workers can do this along with their normal duties.

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AUTOMATION abstracts

DEVELOPING THE TEAMWORK TO SHORTEN LEAD TIMES

By LESLIE W. SMITH
Ass't. Production Mgr.
Bristol-Myers Products Div.
Bristol-Myers Co.
Hillside, N. J.

PRODUCTION of "deals"—multiple consumer items packaged together—usually requires a type of manufacturing engineering that calls for development of economical automatic packaging equipment within extremely short lead time periods. Generally, the equipment must be justified on the basis of a single run. A description of a Mum deodorant deal recently requested by the Sales Dept. of Bristol-Myers Co., and its mechanization, will demonstrate some of the principles involved in this type of engineering.

The deal, *Fig.* 1, comprised two sizes of deodorant and a chipboard riser packaged together. Production of 1,440,000 deals was to begin after a 6-week lead time and be completed after a 1-month operating period. The deal was to be a one-shot proposition.

Committee Action

Our first step was to call a meeting and present the plan to the operating department head and his assistant, the technical assistant, the machine shop foreman, unit foreman, and floorlady. Suggestions were elicited from each person in the group. Among the ideas that were brought out were:

1. Apply glue to bottoms of cartons.
2. Carry card on a chain conveyor.
3. Rotate printing on cartons 90 degrees so that the tuck ends of the cartons would be on the sides of the cartons. This would eliminate the possibility of jars falling out the bottoms of the deals through the tuck flaps.
4. No printing on bottoms of cartons where glue was to be applied.
5. Add pitch as well as glue (the pitch dries quickly and will hold cartons on card until glue has had a chance to set).
6. Use standard production lines for packaging the two sizes of deodorant prior to final assembly on special machine.
7. Estimate cost of assembly machine and lead time for its construction.
8. Build special machine for assembling complete deals at a rate of 120 per minute.

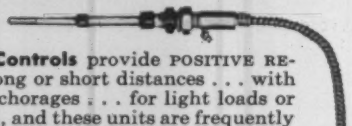
Since the key to the whole operation was our ability to build an assembly machine in a short time, all of our efforts were concentrated on providing this equipment. The time schedule left us no leeway for a complete engineering job, so years of experience and ingenuity were relied on. After 2 days of study, we arrived at a cost estimate of $4000 to complete the machine. This expenditure was approved, and we were off.

It had been agreed that since this piece of equipment might be used only once, we would use only standard gears, bearings, chains, sprockets, and electrical equipment. As it turned out, 80 per cent of the material used could have been taken off the machine when the deal run was completed and placed back into stock. The machine, *Fig.* 2, was built in just 3 weeks and, of course, required overtime work.

In operation, a backlog of cartons was maintained ahead of the machine. The backlog was accumulated during short stop periods of the assembly machine

Fig. 1—Typical "deal" item includes two sizes of standard product assembled to chipboard riser. Sales program requirements necessitated design and construction of an automatic assembly machine in short lead time.

Improved Operation of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* PUSH-PULL Controls

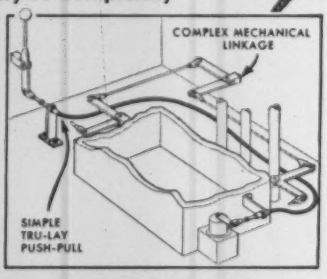


Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts . . .

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

Lubrication of the inner working member is for life.

Temperatures as low as —70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

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and from running the filling and carton packaging lines at a rate higher than 120 per minute. This provision for float stocks is very convenient for maintaining production during 1 and 2 minute downtimes that can occur on any production line.

An interesting side light to this operation is that we did not disassemble the assembly machine when the deal was completed. Instead, it was placed in storage. Subsequently, our Sales Dept. asked for another Mum deal. Although it was different from the first, we found that for $1000 we could redesign this piece of equipment to run the new Mum deal. This was done, and the second deal was also run with high quality at low cost per unit.

Training Program

It goes without saying that a piece of equipment of this type cannot be built without serious thought and cultivation of the most important single factor in industry today—the human element. This element, vital in all our production, takes on added importance in deal operations. An item run on standardized equipment that has been developed over the years is perfected toward the goal of as little human attention as possible, whereas a deal assembly unit just does not have years of little changes to protect it. You can build only so much into a piece of equipment in a period of, say, 6 weeks. Therefore, the human element is of necessity more important.

Training of our workers in handling deal packaging emanates directly from our standard method of training. We use a rotation and grading system for our operators which takes about 3 years to complete. A girl is trained on the cartoners, bundlers, fillers, cappers, etc., and throughout this period receives credits for proficiency on each of these machines. This rotation and experience on different types of equipment gives an operator a mechanical sense which helps her adjust to the unusual automatic deal machines.

Our line supervisors, foremen, and floorlady receive company-run courses on work simplification. These are held on company time. These courses are repeated every 2 or 3 years for new supervisors and to serve as refreshers for older ones.

Our unit mechanics spend from 6 months to a year working in the machine shop. They are all qualified to do simple lathe and milling machine type jobs. When a deal machine is being built, a unit mechanic will spend the last week of construction in the machine shop working on the unit. He is present at the test running, along with the floorlady, unit supervisors, and usually a packaging line operator.

For the last 4 years, the machinists and machine shop foreman have been put in charge of the production unit at least 3 weeks of each year. Also, they work with the unit mechanic on installation, replacement, and repair of production lines. We have felt it a mistake to have a strict line of separation between unit mechanics and machinists. Our machinists would be better classified as production machinists because, in addition to ability as Class A machinists, they have the technical knowledge of high-speed production equipment such as cartoners, fillers, labelers, etc. We are fortunate in having our maintenance section in the

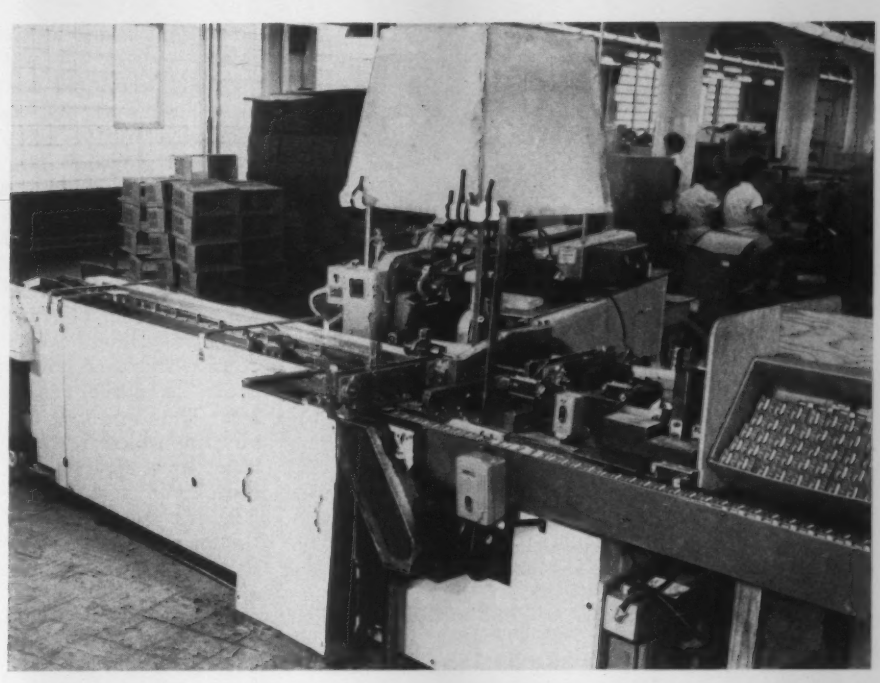

Fig. 2—Where possible, automatic machine for assembling deal components uses standard catalog items—bearings, gears, chains, sprockets, etc.—to reduce initial cost, facilitate construction, and permit re-use of parts on other jobs.

middle of our production area. This lends itself to free interchanging of ideas between unit mechanics and the machinists—giving us a definite, team-like organization.

We have a 3-year apprenticeship system in which a man can become a unit mechanic or a machinist. This course includes going to a recognized trade school at night, and spending so many hundreds of hours in

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FEEDMATIC-DETROIT AUTOMATED EQUIPMENT

Now, you can speed small parts production and cut costs with new Feedmatic electrically controlled machines. These units automatically and continuously feed, inspect, segregate or assemble parts at greater efficiency . . . reduce handling costs on high volume operations. Use Feedmatic automated machines separately or for high speed delivery to machine tools, heat treating furnaces or final assembly areas.

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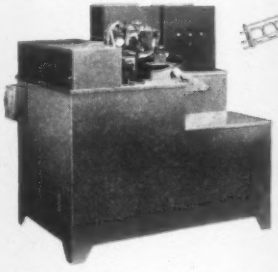
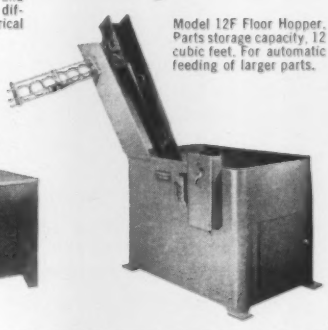
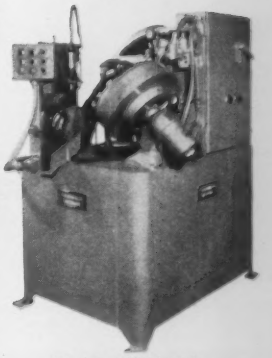
Automatic Gaging Machine measures and sorts parts. Adjustable stops, anvils and gage heads to facilitate change over to different size parts. Tolerance of electrical gages adjustable from .0005 to .020.



Model 12F Floor Hopper. Parts storage capacity, 12 cubic feet. For automatic feeding of larger parts.



Rotary hopper unit. Fast, efficient parts feeding. Available in sizes from 8" to 24". Feed tracks engineered to meet specific job conditions.



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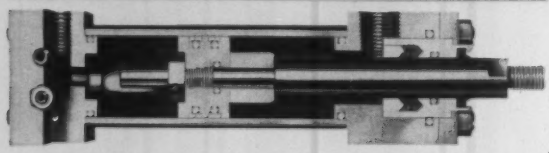
The folder gives operating and environmental specs, coil data, contact capacities, dimensions, diagrams of contact and wiring arrangements. *Write:* Dept. A33-523.

AGA Division — **ELASTIC STOP NUT CORPORATION OF AMERICA**
Elizabeth, New Jersey

Circle 734 on Page 17

LYNAIR AIR and HYDRAULIC CYLINDERS



Pictured is the 2000 PSI Hydraulic Cylinder, an outstanding series in the heavy-duty Lynair line . . . A complete range of sizes . . . Cylinders meet JIC standards . . . Airdraulic Cylinders for the action of hydraulic cylinders using air pressure.

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From a paper entitled "Gearing the Production Line to a Buyers' Market" presented at the 20th Annual Forum of the Packaging Institute, Chicago, Oct. 1958.

PROGRESS IN AUTOMATIC CODING FOR BUSINESS DATA HANDLING

By GRACE M. HOPPER
Automatic Programming Development
Remington Rand UNIVAC Div.
Sperry Rand Corp.
New York, N. Y.

STUDIES of the costs of programming business data processing problems have indicated that these costs are too high. This is true for the initial job of getting a system on a computer, for the changes required for normal maintenance of the programs, and for the alterations suggested by the evolution of a smoothly running system. Use of a computer such as the Remington Rand UNIVAC Data Automation System to assume part or all of the coding burden was indicated by experience with automatic coding for mathematical and engineering problems. The substitution of a computer to execute a part of the programming task demonstrated a need for re-examination of the whole task and for evaluation of its component parts.

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It was found that the definition of "programming" was vague. To some, it meant only producing and debugging computer coding; for others, it included system analysis and problem definition. Traditionally —if there can be tradition in such a youthful industry—the programmer's task had included numerical analysis and selection of the approximation technique, flow charting, preparing computer code, debugging, and supervising the production running of the problem. Programmers were selected for training on the basis of degrees or backgrounds in the mathematical and exact sciences. Learning another symbology—the computer code—was a normal development in the working life of a mathematician. The problems with which he dealt were stated in familiar concepts and symbols.

At first the professional mathematician was attracted by the new problems of minimizing storage requirements and increasing computational speeds, but it was not too long before this mathematical programmer became bored with the continual rewriting and recopying of groups of instructions which could be included by more powerful symbols. This line of thinking—together with the desire to write such "subroutines" into a program only once, in order to conserve storage space—led to "interpretive" routines. These systems served to reduce training time, to make the computer more directly available to scientific personnel, and to shorten debugging time.

However, the interpretive routine increased computation time by the amount of time required for the intepretation of pseudo, or macro-instructions. Compiling routines met this problem by interpreting the pseudo code only once and writing a computer-coded program ready to run the problem. Starting in 1952, compiling routines for mathematical problems have steadily achieved greater degrees of sophistication both in the pseudo codes and in the efficiency of the running program produced.

Simultaneously with the development of interpretive and compiling routines, the techniques of coding in a relative notation were developed. These permitted subdivision of programs and assignment of sections to several individuals. Assembly routines are used to combine these sections, allocate storage, and reduce latency time if required. The interpretive and compiling routines were aimed at assisting the noncoder. The assembly systems, some of which shared abilities of compilers, were designed primarily to assist the programmers and coders.

Initial Resistance

The first attempts to carry automatic coding techniques into the data processing field met with almost complete rejection. There were such comments as: "The programs are not of the ultimate efficiency," and: "The systems are cumbersome." Reactionary programmers could not believe that a computer could produce a routine which could compete effectively with hand-tailored coding.

At this time it became acutely necessary to re-

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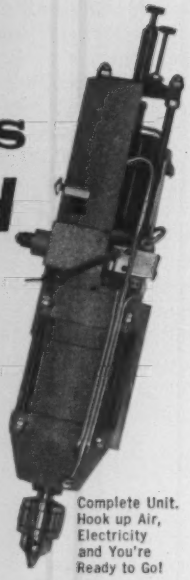
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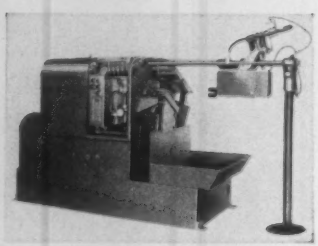

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examine the entire sequence of events by which a "problem" or business system was transferred onto an electronic computer. Clearly, there were several steps in this procedure, and each step required a different type of background and training of the personnel involved.

On the basis of previous experience in programming scientific problems, it was clear that the first possible point of attack was to replace the coder with the UNIVAC Data Automation System itself, keeping in mind the hope of eventually assisting the programmers and ultimately the system analysts. Thus the problem could be stated in 1955 as: Given—some form of block chart or flow chart; required—a program to produce computer coding for production running. This implied designing a system including a charting technique, a pseudo code, a method of describing data, a compiler and its library, service routines, and operating and debugging aids. Several basic objectives could then be immediately stated:

1. The charting technique and pseudo code to be employed, and not a computer program, must describe the problem. This condition led to the further statement that the pseudo code must be independent of any particular computer hardware, and that it must be easy for analysts to use with a minimum of instruction and a minimum of new symbology to learn.
2. The system developed must produce a highly efficient production program taking full advantage of each computer component and facilities.
3. Service routines must be provided to facilitate debugging of the resulting program and for maintenance of the compiling system, just as service routines have been developed for computers.

Stumbling Blocks

In almost no case were the subroutines alike in any two installations. Where it had been possible to freely transmit mathematical subroutines from one installation to another, it did not seem possible to exchange data-processing subroutines. While the computation of the square root of a floating decimal number remained the same in Pittsburgh, Los Angeles, and New York, the computation of gross to net pay obviously did not remain the same even in two installations in the same city. Not only did the arithmetical steps differ, but the positions and relationships of the input data in the several files varied greatly, causing corresponding subroutines to bear but a skeletal resemblance to each other. Even in the cases of common computational sequence such as FICA and income tax deductions, differences in the data format gave rise to different subroutines. Obviously, it is a labor beyond the power of a Hercules to persuade business establishments to use a common data format, except in the case of forms such as those required by the Internal Revenue Service.

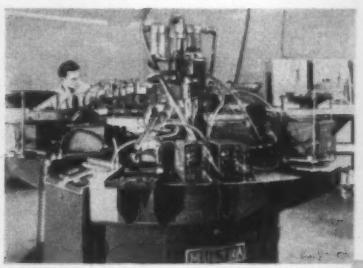
Two requirements then are clear:

1. To provide a method of describing business data such as files, items, records, messages, fields, and the like.
2. To provide a means of writing, for a particular operation, the subroutine to execute that operation on the corresponding data.

Envisioning, then, a system for coding business problems, the concept takes shape as a compiling system with an associated library of "generators," service routines, and data descriptions. From the condition that systems and methods personnel be permitted to state problems in their customary language followed the conclusion that a pseudo code must employ English words forming comprehensive if temporarily stilted sentences. Pursuing this line of thought, each sentence must correspond to an operation to be performed by the computer. Thus the sentences become imperative instructions to the computer. Further, since such sentences are to serve for any computer, the verbs initiating these operations must be sufficiently broad in action to transcend the computer hardware. Such orders as: "Compare inventory on hand with inventory limit; if greater, go to operation 19; otherwise, go to operation 13," or: "Deduct group insurance amount from adjusted pay, increment accumulated group insurance, and increment total other deductions," carry no implication that the computer involved has either drum or magnetic-core storage. The statement: "Input time-data file A, payroll file B," carries no indication that the data have been recorded on punched cards, paper tape, or magnetic tape.

The verbs of such sentences correspond to "generators" in the library of the compiler; the nouns correspond to "data-descriptions" either stored in the library or accompanying the run description. Both terms require further definition. In the case of mathematical computation, it was sufficient to use a library of "two-word, floating-decimal subroutines." It was then defined and determined that quantities would be recorded in two computer words, the first containing the normalized mantissa and the second the required power of 10. In data processing, the quantities treated are not necessarily numbers of a single type but will include names and addresses, deduction codes, stock numbers, and stock numbers of substitute parts. Hence the data descriptions become more complex. For example, for each file it must be stated whether or not it is multireel, whether a block or record count is desired, and the form of the reel labels. Any sentinels used in the file must be named. For each item or record, its noun name and its size (if standard) must be given, accompanied by the names of any keys used in sorting or merging the items. A field descriptor must include at least the size, the position of the field in the item, and the positions of its sign and decimal point along with its name. Once such descriptions have been written, meaning has been given to such terms as "master payroll file," "inventory limit," "stock entry," or "shift code." Each installation may thus define its own noun vocabulary as required by the work to be performed and may retain its own familiar references.

Turning to the verbs, these correspond to the "generators" stored in the tape library of the compiler. When the phrase "compare inventory on hand with inventory limit" is referred to the compare generator, the reference is accompanied by the descriptors of the two nouns. The generator can then write the exact,



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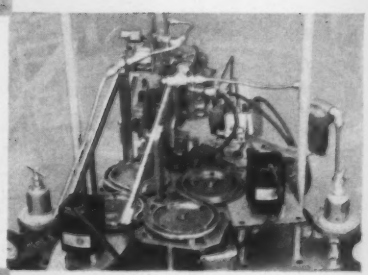

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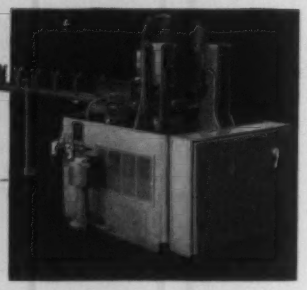

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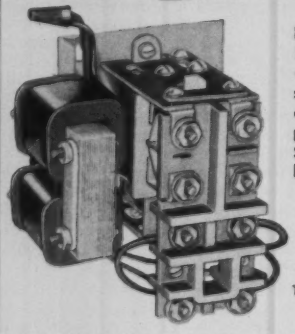

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compact section of coding required to perform the particular comparison. Where an input-output generator receives the statement that the input is to consist of "time-data file A and payroll file B," it refers to the file descriptions to discover that the payroll file is multireel and will require "servo-swaps," that its label is of the form "PAYNNN YYMMDD" (indicating payroll, reel NNN; date in the form of year, month, and day). All the information necessary to write the intricate input-output coding is available to the generator. It should not be surprising that it is possible to build such powerful generating routines—a single generator may be able to produce any one of thousands of possible specific static subroutines.

The procedure of program compilation is a data processing procedure. Two files of information are supplied: The English sentences (the pseudo code) stating the sequence of operations to be performed, and the data descriptions giving the subjects of the operations. These two files of information are processed by the compiling and generating routines to produce a third file of computer instructions—the production program. Automatic coding systems based on these techniques are applicable in business today.

Demonstrated Advantages

What effect does this have on the over-all problems? One phase has been eliminated—the coding. A second phase, that of programming the system for the computer, has been assisted. Some of the most intricate and tricky coding—the input-output, matching and ending routines, and the logical manipulations that total at least 70 per cent of all data processing runs—have been wrapped up in neat packages to be delivered by the generators at the instigation of but two or three sentences. The systems analyst and the programmer are freed to spend their time on the definition and improvement of the system instead of on machine programming and coding.

There are two next steps: One is to produce a compiler with which to make compilers, and the other, to advance into the area of programming itself. Building on existing automatic coding systems, an automatic programming system will be produced. It has been proved that such routines are feasible.

Where do these steps lead? The future and ultimate application of data processing computers in the business environment will depend upon the development of automatic techniques which will both facilitate and economize the process of application of the equipment to new business problems. It is increasingly apparent that the surface has hardly been scratched in exploiting the potential uses of computing systems in business. However, if electronic data processing is ever to become an automatic, instantaneous information source for business management, methods of automatic programming and automatic information control must be developed to a greater degree.

From a talk entitled "Automatic Programming" presented at a Conference on Computer and Data Processing in Industry sponsored by Purdue University, Feb. 1959.

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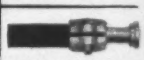

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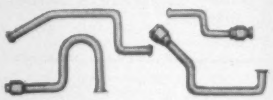

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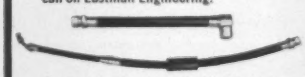

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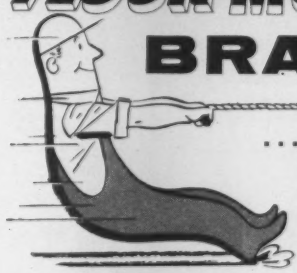

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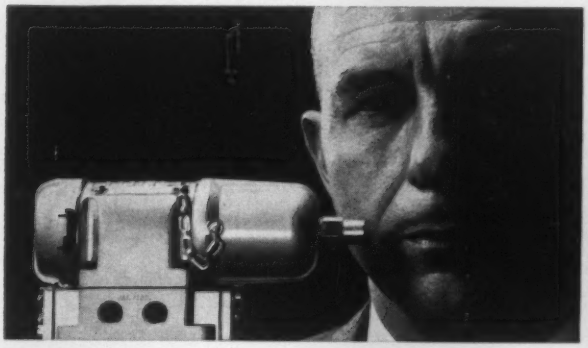

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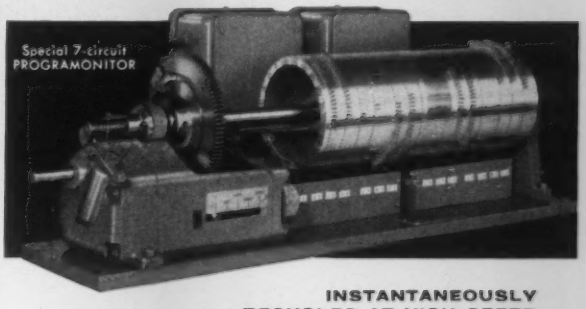

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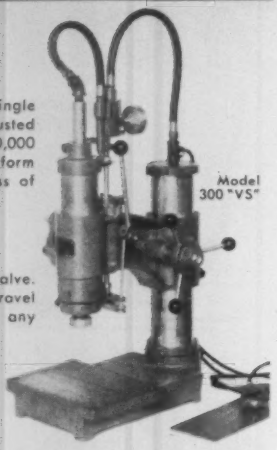
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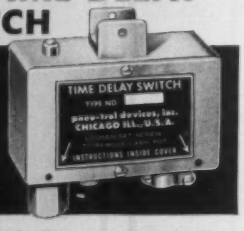

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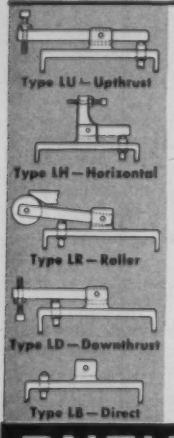

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Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1822-P

CLOSURE FEEDING

. . . We have a feeding problem in connection with a proposed assembly operation. It is proposed to employ an automatic oriented position feeder with five tracks for feeding our assembled Turn-Lock Closures to a radial type assembly device for fibre drums. Two of the five feeder tracks would not be used for some runs. . .

Chief Engineer

CASE 1824-P

SHEET GAGING

. . . We are interested in locating equipment for automatic measuring of sheet steel within the range of ¼-inch plate to 16 ga. sheet. We would also use this for aluminum sheet and stainless steel sheet. We would prefer this instrument to be able to count the number of sheets in a bundle without opening or loosening the straps on the bundle. The purpose of using this equipment is to sort the steel out as to decimal variances within a standard gage of material. . .

Plant Manager

SUGGESTIONS FOR 1674-P (JAN. 1959)

OIL METERING

. . . It would appear that one of our Gravimetric meters could very well handle this particular requirement. . .

R. J. Brearton
Revere Corp. of America

. . . Ramapo Instrument Co. manufactures such a flowmeter, and we would appreciate the opportunity to discuss this application. Descriptive literature is enclosed. . .

George W. Anderson
Ramapo Instrument Co. Inc.

. . . We build density gaging equipment and are in a position to supply other people's flow meters along with circuitry to give mass flow. . .

W. E. Van Horne
Industrial Nucleonics Corp.

SUGGESTIONS FOR 1732-P (FEB. 1959)

TAPE PUNCHES AND READERS

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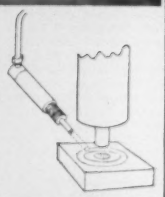

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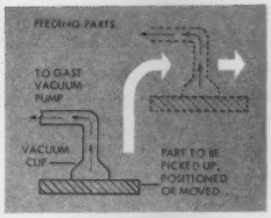

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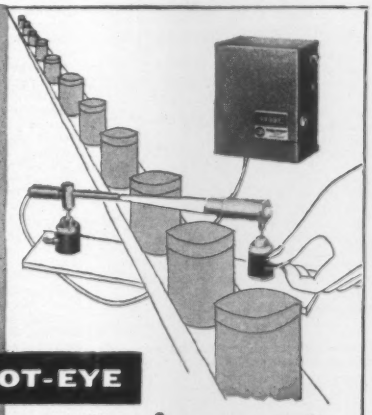

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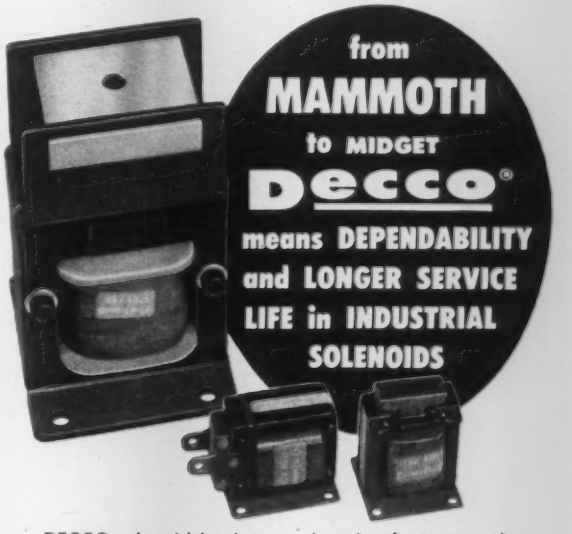

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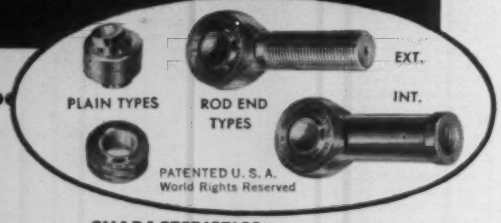

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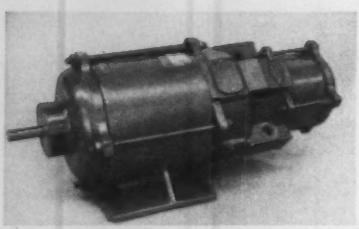

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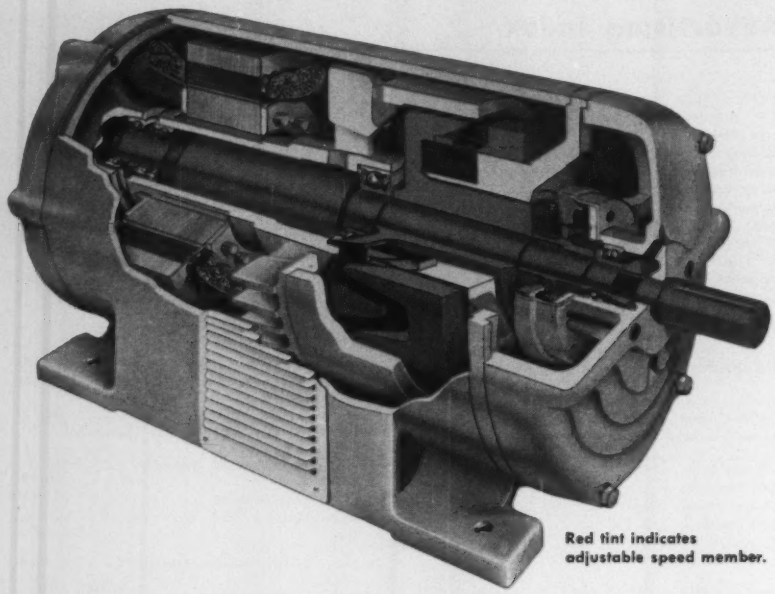

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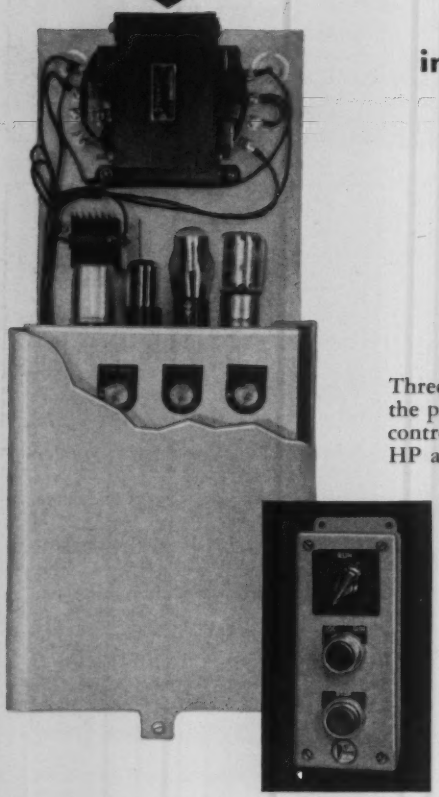

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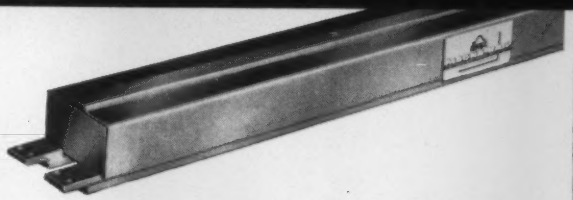

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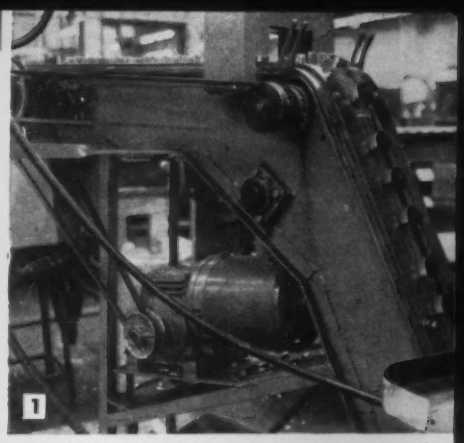

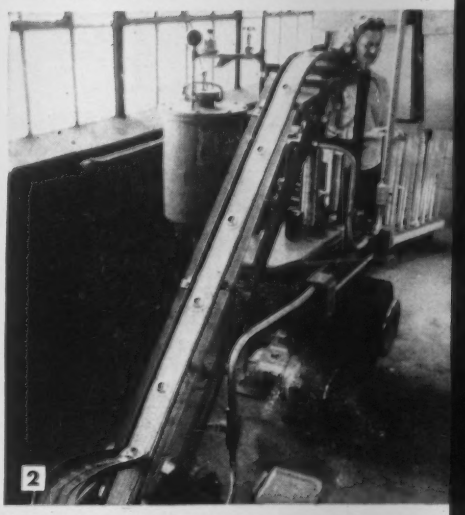

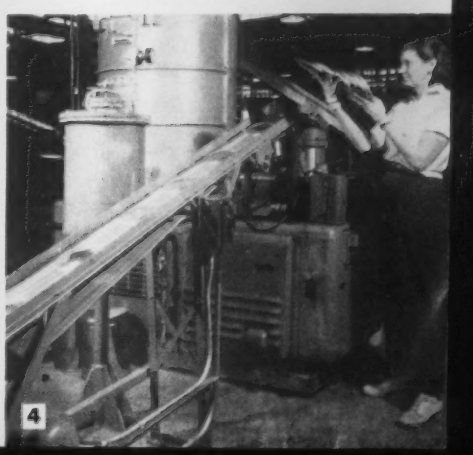

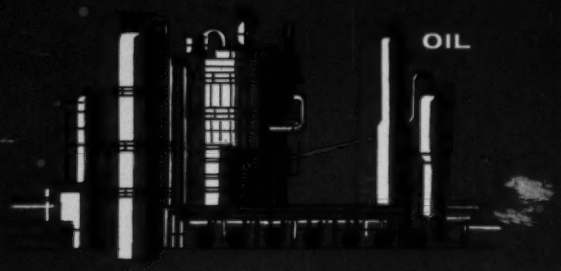

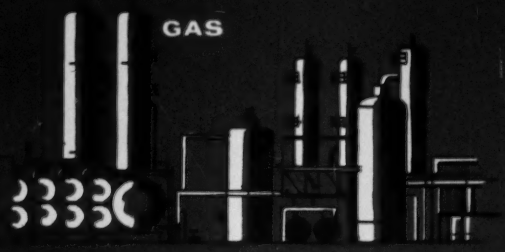

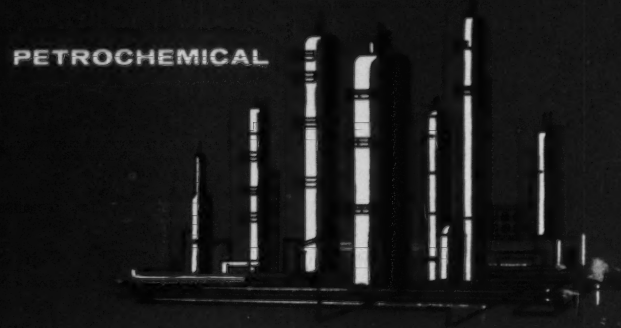

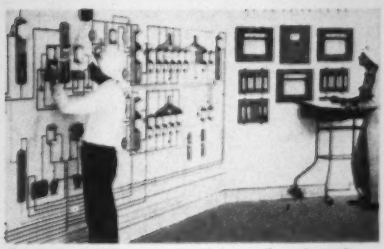

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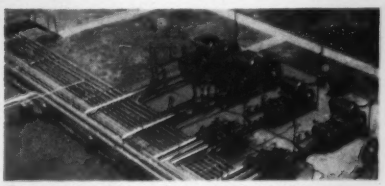

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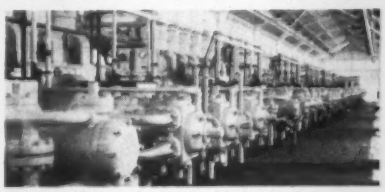
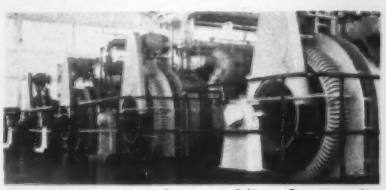


Omniguard system protects this bank of compressors installed at a natural gas cycling plant.



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THOMAS A.

EDISON

omniguard system provides reliable, flexible temperature monitoring for oil, gas and petrochemical industries

Throughout your process, wherever temperature is critical, the Edison Omniguard system can protect vital equipment and output quality. It is the simplest and most flexible temperature monitoring system devised.

Plug-in detector units may be installed at key points throughout the process. They can be added or switched without disturbing the system. Typical detector locations include motor and motor bearings in shipping pumps, compressors and generating stations. Individual alarm settings on each point can be changed at any time without special tools.

Indicating panel can be located in central control room, for complete overall process monitoring by a single individual. Alarm system positively identifies trouble point.

The complete system is designed for utmost reliability. There are no moving parts, nothing to wear out.

Edison engineers will be happy to provide assistance in designing the most efficient system to meet your requirements.

For additional information write for publication 3036-C.

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